

# **Redefining RECs (Part 1)**

*Untangling attributes and offsets*

Discussion Paper  
Version 2

August 2007

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# Redefining RECs (Part 1): Untangling attributes and offsets

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## Abstract

Renewable energy and greenhouse gas emissions markets are currently in a state of confusion regarding the treatment of Renewable Energy Certificate (RECs). Should consumers buy RECs or emission offsets? After examining this question, the author concludes that RECs are not equivalent to emission offset credits, and as currently defined, the retiring of a REC may have no impact on emissions from electric power generation. Consumers that purchase RECs in voluntary green power markets are providing financial assistance to renewable generators in the form of a production subsidy. Generators that sell RECs are not transferring emission reductions, since they are unlikely to have ownership or the ability to quantify reductions using a commonly accepted standard. More importantly, RECs currently sold in voluntary markets do not pass credible additionality tests and can, at best, be expected to have a market demand effect, which will be less than the supply of RECs on the market. REC definitions that use the term “environmental attributes” or “environmental benefits” are almost universally ambiguous, providing the mistaken impression that consumers are purchasing a good instead of subsidizing a public good.

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## 1 Introduction

Tradable environmental commodities are becoming a favored instrument for policy makers. Renewable Energy Certificates (RECs) are one type of environmental commodity intended to provide an economic incentive for electricity generation from renewable energy sources. A REC is created when one (net) megawatt hour of electricity is generated from an eligible renewable energy resource. Typically, RECs are unbundled, and sold separately, from the underlying electricity generated.

A behind-the-scenes debate has been raging within the environmental markets and renewable energy communities regarding the proper definition of a REC, what a REC represents, and whether RECs should be treated as equivalent to emission offsets. Emission offsets represent the avoided release of a unit mass of a pollutant to the atmosphere. Offsets offer buyers an alternative to reducing their own emissions, which they may be unwilling or unable to reduce at a lower cost.

The root of this debate is the fact that RECs are being used for multiple applications in multiple markets. Each of these applications entails conflicting requirements for an environmental commodity. Carefully addressing these conflicts is essential given the interactions between renewable and emission markets. This paper (Part 1) will focus on the relationship between RECs and emission offset credits. A more general discussion on the relationship between RECs and emission markets, along with recommendations for how to resolve conflicts between REC and emissions trading markets, is provided in a second paper (Part 2) (Gillenwater, 2007).

Both compliance and voluntary environmental markets use RECs. In the United States, compliance markets have been established by state Renewable Portfolio Standards (RPSs). Several states allow or require load-serving entities (LSEs) to use tradable RECs to meet a quota for the amount of their delivered electrical load that must be met by electricity from renewable generation. Both voluntary “green power” markets—which provide retail customers the choice to pay a premium to electricity generators

using renewable resources—and voluntary greenhouse gas offset markets trade in RECs.<sup>1</sup> No single commodity is an appropriate tradable instrument for all of these applications.

Two fundamental problems exist within many REC markets. First, most REC products are ambiguously defined and are purported to represent attributes indirectly associated with renewable energy generation, resulting in their inability to function as a homogeneous commodity. A typical definition of a REC includes language such as “RECs represent all environmental attributes or benefits from electricity generated by renewable sources,” although there is wide variation in the language and specificity of definitions used in both the compliance and voluntary markets (Holt and Wiser, 2007).

Second, RECs are used for multiple applications, each of which requires an environmental commodity with different characteristics. Many of these definitions imply questionable claims regarding the impact of RECs on electricity markets and pollutant emissions from the electric power industry. Specifically, RECs have become popular with marketers, corporations and individuals to offset their greenhouse gas (GHG) emissions (Bird et al., 2007). Their argument is that the generation of electricity by a renewable facility, such as a wind turbine, avoids or displaces generation, and therefore emissions, from a fossil fuel-fired power plant..

This paper examines the following questions regarding renewable energy markets and emissions markets:

- Are RECs equivalent to or fungible with emission offsets?
- What are consumers of RECs buying?

Others have addressed the issue of defining RECs, but few systematic analyses or comprehensive solutions have been proposed (Bird et al., 2007; Holt and Bird, 2005; Jansen, 2003; Leahy and Hathaway, 2004). This paper attempts to answer the above questions by first looking at the history of RECs and existing definitions. It will then analyze RECs and associated emission reduction claims according to three characteristics: additionality, ownership, and quantification.

The concept of additionality—that a project activity is beyond business as usual—is fundamental to emission offset accounting. Both RECs themselves and any associated emission reduction claims can be evaluated against various additionality tests. Ownership issues relate to the ability of REC owners to claim property rights or make marketing claims regarding the impacts of renewable energy generation that occur off-site from the renewable generation facility. And quantification issues relate to the complexity of credibly quantifying the impact of renewable generation on a networked electrical transmission grid. Before further discussing these characteristics, however, it is instructive to examine the historical origins of RECs and current REC definitions used in compliance and voluntary markets.

## 2 A brief history of RECs

RECs were originally proposed during the U.S. electricity restructuring debates of the mid-1990s as a tradable environmental commodity and accounting device for renewable energy policies. The concern at the time was that competitive electricity markets would drive renewable energy generation out of the market (Rader and Norgaard, 1996; UER, 1996b; Wingate and Holt, 2004; Wood, 2007).

Some of the earliest discussion of RECs was in 1995 during the California Public Utilities Commission’s debates regarding the adoption of a RPS (Holt and Bird, 2005). News articles at the time described RECs as “credits [that] would be tradable like emission allowances under the federal Clean Air Act” (UER, 1996a, c).

An RPS was not mandated in California at that time, but the concept of tradable RECs entered the debates in Congress over the repeal of the Public Utility Holding Company Act (PUHCA) and amendments to the Public Utility Regulatory Policies Act (PURPA). In order to promote renewable energy in a competitive generation market, several bills called for a national RPS that included the use of

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<sup>1</sup> RECs may also be used by LSEs to track their generation mix for public disclosure purposes on retail electricity bills (Holt and Bird, 2005).

tradable RECs for determining compliance.<sup>2</sup> Here too, the model for a REC was an emission allowance under the recently implemented sulfur dioxide (SO<sub>2</sub>) trading program under Title IV of the 1990 amendments to the Clean Air Act.

Despite the failure of these federal bills to become law, several states and localities proposed RPS legislation that included tradable RECs.<sup>3</sup> In 2001, Texas was the first state to implement an RPS after passing the enabling legislation in 1999 (Holt and Bird, 2005; Sloan, 2001).<sup>4</sup> The Texas RPS required LSEs to use RECs to track compliance.

Around the same time, RECs were adopted by non-governmental organizations (NGOs) in the United States and Europe as an instrument to promote voluntary markets in green power (Martinot et al., 2005; Morthorst, 2000; Voogt et al., 2000).<sup>5</sup>

The history of an idea matters, and it is clear that RECs were originally conceived as an instrument to be used to meet a regulatory quota, analogous to an emission allowance.<sup>6</sup> This distinction is important when we consider today's environmental markets in which RECs are traded. Despite this history, the definition of RECs, like other environmental policy instruments, can be modified as needs change. So what types of environmental commodity instrument could a REC be defined as?

### 3 Environmental markets and market instruments

For the past several years, renewable energy markets and emissions markets have developed in parallel. Both regulated compliance and voluntary versions of these markets exist. Two fundamental types of tradable commodity instruments operate in these markets: quota instruments and offset credit instruments. The difference between these two types of instruments can most simply be explained in terms of the boundaries of a trading scheme and the accounting basis used.<sup>7</sup>

#### 3.1 Quota instruments

The demand for quota instruments by entities within a defined boundary is predetermined. The quota instrument serves as a tradable commodity and the regulatory quota creates a scarcity. Entities within the boundaries of a scheme with a quota (e.g., cap) are required to submit a certain number of quota instruments to comply with the scheme. Allowances under an emissions cap-and-trade scheme and RECs under an RPS are examples of quota instruments. An allowance is a transferable commodity that legally confers the legal authorization to an entity to take some action (e.g., to emit a unit amount of a pollutant) without facing a penalty. Similarly, a REC is proof that an entity has taken a required action (i.e.,

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<sup>2</sup> For example, see H.R. 3790 "Electric Consumer's Power to Choose Act of 1996" (Schaefer, CO) in July 1996; as well as S.237 "Electric Consumers' Protection Act of 1997" (Bumpers, AR) and H.R.1960 "To modernize the Public Utility Holding Company Act of 1935, the Federal Power Act, the Fair Packaging and Labeling Act, and the Public Utility Regulatory Policies Act of 1978 to promote competition in the electric power industry, and for other purposes" (Markey, MA) during the 105<sup>th</sup> Congress.

<sup>3</sup> For example, see (UER, 1997)

<sup>4</sup> Texas was the 6<sup>th</sup> state to pass RPS legislation, but it was the first state to promulgate and implement rules.

<sup>5</sup> In January 1998 a voluntary renewable energy certificate system called "Green Label" was introduced in the Netherlands. In 2002, the Center for Resource Solutions in San Francisco launched the Green-e certification label for renewable energy retail renewable energy sales, including RECs.

<sup>6</sup> Unfortunately, the original terminology for a REC in Congressional legislation was "renewable energy credit," which probably fostered confusion with emission offset credits.

<sup>7</sup> Environmental commodities are intangible instruments. In most cases, they are only a record in a registry database. Therefore, transacting an allowance, REC, or offset credit is simply an act of information management. Anyone can potentially buy an environmental commodity from anywhere. Trading in environmental commodities makes most sense where the geographical extent of environmental good or harm represented by the environmental commodity is not localized. For example, greenhouse gases have long atmospheric lifetimes and mix well in the atmosphere.

purchased a unit of electricity from a renewable generator) or has the right to sell a commodity representing that action.<sup>8</sup>

As of the end of 2006, twenty-one states and the District of Columbia had mandated RPSs in the United States.<sup>9</sup> However, only eighteen of these states allowed the use of tradable RECs<sup>10</sup> and neither REC definitions nor nomenclature is consistent across states (see Appendix A and B). REC definitions vary in the restrictions placed upon trading and what a REC fundamentally represents. In practice, these restrictions create separate local compliance markets for RECs.

Consumers can directly participate in renewable energy markets by purchasing generating equipment and installing it on-site, enrolling in green power pricing programs, purchasing renewable power directly from generators in competitive electricity markets, or purchasing RECs (Bird and Swezey, 2006; Pino, 2006).<sup>11</sup> Although much smaller than RPS compliance markets, voluntary REC markets are growing rapidly in the United States (Table 1) and in Europe.<sup>12</sup> The voluntary purchase of RECs accounted for 46 percent of U.S. consumer green power sales in 2005, and REC markets are growing faster than other segments of green power markets. The voluntary market for RECs is dominated by commercial and industrial customers, versus residential customers who are more likely to utilize local green pricing programs (Bird and Swezey, 2006). The advantage of RECs in voluntary markets is that they can be sold unbundled from electricity, and so their market is national, while green power markets tend to be tied to local providers.

**Table 1**

Estimated consumer green power sales by market sector in the United States (thousand MWh)\*

<b>Market sector</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>Average annual change</b>
Utility green pricing programs	1,280	1,840	2,450	39%
Competitive generation sales	1,900	2,650	2,150	10%
<i>REC markets</i>	<i>660</i>	<i>1,720</i>	<i>3,890</i>	<i>144%</i>
<b>Total</b>	<b>3,840</b>	<b>6,210</b>	<b>8,490</b>	<b>50%</b>

\*In 2005, total voluntary market green power sales were about 0.2 percent of total U.S. electricity sales. Wind energy provided 61 percent, followed by biomass energy sources, including landfill gas (27 percent), hydropower (6 percent), geothermal (5 percent), and solar (1 percent). Data taken from (Bird and Swezey, 2006).

<sup>8</sup> It would be feasible to design an RPS scheme in a way that is more analogous to a cap and trade system. Under such an approach, a cap would be set on the amount of non-renewable electricity that LSEs are permitted to utilize to meet their load instead of the amount of renewable electricity they must utilize. The effect on the generation mix should be equivalent to a traditional RPS design. However, an absolute cap on non-renewable generation could provide incentives for LSEs to invest in electricity demand reduction, unlike an RPS.

<sup>9</sup> Several utilities have also adopted RPS policies. See the Database of State Incentives for Renewables & Efficiency (DSIRE) at <http://www.dsireusa.org/>

<sup>10</sup> If tradable RECs are not allowed under a state's RPS, then LSEs must either own and operate their own renewable generation or contract for electricity wholesale from renewable generators, which is then tracked for compliance with the RPS.

<sup>11</sup> RECs are often re-bundled by utilities and marketers with wholesale electricity and sold to retail customers as a green power product. When retail consumers purchase RECs directly and then retire them, these customers are effectively re-bundling RECs with their electricity. For a list of green power marketers see <http://www.eere.energy.gov/greenpower/markets/marketing.shtml?page=2>

<sup>12</sup> In September 2001, the European Commission passed Directive 2001/77/EC, which calls for member states to set quantitative targets for electricity consumed in the country produced from renewable energy sources. A European Energy Certificate System (EECS) is being developed to register and track an environmental commodity called Guarantees of Origin (GoOs), which are replacing RECs in the voluntary green power market in Europe. The voluntary market for green electricity in Europe varies greatly among countries. It is significant in the Netherlands, Germany, and Sweden. [http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/l\\_283/l\\_28320011027en00330040.pdf/](http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/l_283/l_28320011027en00330040.pdf/)

### 3.2 Offset credit instruments

2 Voluntary GHG markets are examples of markets that trade in offset credit instruments. The  
4 accounting for offset credit instruments is based on some type of activity baseline. Typically, this baseline  
6 is assumed to represent some “business-as-usual” (BAU) level of activity, such as forecasted emissions.  
8 Credit is then awarded for the amount that a project causes an activity level to deviate from this baseline  
(e.g, baseline emissions minus actual emissions). In contrast, the accounting basis for quota instruments is  
typically an absolute level of activity (e.g., total emissions).

8 The demand for offset credits can come from two sources: (1) entities under a quota that purchase  
credits from project activities implemented by entities not subject to the quota; and (2) entities and  
10 individuals that voluntarily purchase and retire offset credits for the purpose of making environmental  
claims regarding their support of some public good. If sold into a compliance market with a quota (i.e., #1  
12 above), offset credits have the effect of reducing the scarcity of tradable commodities in the market. An  
example of an offset credit instrument sold into a compliance market is a Certified Emission Reduction  
14 (CER) under the Kyoto Protocol’s Clean Development Mechanism (CDM). RPS schemes typically have  
not allowed the use of offset credits for compliance, although such provisions are feasible.

16 Because they lack a regulatory mechanism to define compliance boundaries and enforce quotas on  
market participants, voluntary environmental commodity markets are typically viewed as trading in offset  
18 credit instruments.<sup>13</sup> Voluntary emission offset markets are focused almost exclusively on GHG  
emissions.<sup>14</sup> These voluntary GHG offset markets are generally unregulated and lack standard protocols  
20 and nomenclature; some refer to GHG offset credit instruments as voluntary emission reductions  
(VERs).<sup>15</sup> Consumers in these markets include both organizations and individuals who voluntarily  
22 commit to offset their GHG emissions from their operations, events, travel, products, concerts, or other  
activities. Although small, GHG offset markets are growing rapidly in several regions, including North  
24 America and Europe. A recent estimate showed that voluntary GHG offset markets, in aggregate, traded  
an estimated 23.7 million metric tons of CO<sub>2</sub> reductions worth \$91 million USD in 2006 (Hamilton et al.,  
26 2007). A study by ICF International estimated that the voluntary GHG offset market will grow to 200  
million tons by 2010.<sup>16</sup>

## 4 Existing definitions and standards

28 There is little agreement regarding the question of what a REC is or represents. Appendix A presents  
30 a selection of REC definitions used in both RPS compliance and voluntary REC markets. Holt and Wiser  
(2007) also discuss the variation and inconsistency in REC definitions among state RPS mandates.

32 REC definitions often rely on the use of the term “attribute” or “benefit”; however, there is little  
consistency across definitions. RECs are often purported to “include all” attributes or benefits, but there is  
34 rarely any attempt to address what these attributes or benefits include, how they should be quantified, or  
how ownership can be assigned unambiguously. Do these attributes or benefits include both pollutants  
36 directly released by the renewable energy generator and impacts of renewable generation on the broader  
electricity grid? Is there a distinction between an “attribute” and a “benefit?” If a REC includes emission  
38 attributes or benefits, then why denote it in MWh instead of tons of specific pollutants?

40 The language used by participants in the voluntary REC market is quite diverse. Some REC  
marketers make specific claims that RECs include rights to emission reductions from displacing fossil

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<sup>13</sup> The Chicago Climate Exchange (CCX) is a voluntary capped emissions market. Such markets will tend to attract more sellers than buyers. Therefore, the market will tend to be oversupplied and fail to create an economic incentive to reduce emissions.

<sup>14</sup> Voluntary markets exist for purchasing and retiring SO<sub>2</sub> or NO<sub>x</sub> allowances from compliance markets in the United States. The volumes purchased by voluntary participants and retired in these markets are extremely small.

<sup>15</sup> Also referred to as verified emission reductions. For an example see the Gold Standard Foundation’s Gold Standard VER at: [/www.cdmgoldstandard.org/](http://www.cdmgoldstandard.org/)

<sup>16</sup> ICF International, “Voluntary Carbon Offsets Market: Outlook 2007.” [/http://www.icfi.com/Newsroom/carbon-offsets-2006.asp/](http://www.icfi.com/Newsroom/carbon-offsets-2006.asp/)



2 generation (Holt and Bird, 2005). Pino (2006) states that RECS “may include” air pollution and  
greenhouse gas benefits, but she does not specify under what conditions they would or would not.

4 Similar language is used in RPS legislation to define RECs for compliance markets (Holt and Bird,  
2005). A point of particular confusion is the treatment allowances under existing cap-and-trade programs,  
6 such as for SO<sub>2</sub> and NO<sub>x</sub> in the United States. Despite claims implied in many of these definitions, RECs  
have failed to prove that they convey any legal rights to emission allowances allocated to fossil fuel-fired  
generators (Gillenwater, 2007).<sup>17</sup>

8 Groups such as Green-e have attempted to address this issue by including language in their definition  
saying that attributes exclude any pollutant under a regulatory cap. They concede that REC marketers  
10 who use their certification standard must retire an allowance of any capped pollutant as a prerequisite for  
an emission reduction claim of a capped pollutant.

12 RECs have been described as being a “green jewel box” of all good things resulting from renewable  
energy (Jansen, 2003). A minority have argued that RECs simply represent the “unique proof that (i) the  
14 underlying specific quantity of renewables-based electricity has been produced under conditions specified  
by the standard information on the certificate, and (ii) that the certificate has not yet been used for another  
16 application” (Jansen, 2003; Leahy and Hathaway, 2004).

18 The Renewable Energy Resources Committee of the American Bar Association (ABA), the  
American Council on Renewable Energy (ACORE), and the Environmental Markets Association (EMA)  
have recently drafted a Master Renewable Energy Certificate Purchase and Sale Agreement in an attempt  
20 to address the confusion with REC and environmental attribute definitions.<sup>18</sup> The agreement is intended to  
be applicable to both voluntary and compliance REC markets, with the objective of promoting “the  
22 fungibility of RECs across programs.”

24 However, the draft agreement fails to achieve this objective. It provides a detailed framework for  
sellers and buyers of RECs to define RECs specifically for each transaction and defines three categories  
of REC types: “standard”, “basic” and “specified”. Their “standard” REC definition suffers from the same  
26 faults as earlier ambiguous definitions. The agreement’s “basic” and “specified” REC types do improve  
transparency, but the agreement not does create homogeneous commodities for the marketplace that  
28 would be fungible across programs. Deciphering what collection of public goods that any given REC  
might represent requires a careful reading of more than 40 pages of legal contract language plus  
30 attestation statements and verification reports specific to each transaction.<sup>19</sup> The agreement does not  
address the issue of additionality, yet its promoters advertise RECs as a way to reduce GHG emissions.

32 Given the claims made regarding emission reductions within the voluntary REC market, RECs  
should be defined as an offset credit instrument. While RECs used for RPS compliance should be  
34 regarded to be quota instruments. Yet, both voluntary markets and RPS compliance markets fail to make  
this distinction. In sum, RECs are currently defined vaguely or inconsistently and so cannot function as a  
36 single environmental commodity.

## 5 Are RECs additional?

### 5.1 Additionality

38 Additionality is a judgment about cause and effect. The principal cause is the revenue from the  
selling of an offset credit. The effect is an activity with some environmental benefit (e.g., increased  
40 generation from renewable energy sources and/or reduced GHG emissions). The effect is quantified as a  
change relative to a BAU baseline. Additionality tests are a key determinant of whether a project is  
42 eligible to be awarded credits for producing some public good.

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<sup>17</sup> The California REC definition is the most detailed, yet it also fails to address the practical issue of ownership of emission allowances.

<sup>18</sup> See Appendix A and <http://www.acore.org/programs/rectrading.php/>

<sup>19</sup> See flowchart on Exhibit A/Part B, page 31 of the ABA/ACORE/EMA draft master agreement.



2        Additionality is a concept most commonly associated with emission markets, but it is relevant to  
4        other public good markets. Trexler et al. (2006) frames the issue of additionality using a statistical  
6        analogy. Additionality tests control the number of false positives (i.e., crediting bad activities) and false  
8        negatives (i.e., rejecting good activities). The underlying concern is the overall stringency of the  
10        additionality tests, which regulate the supply of credits on the market. Overly stringent tests may  
12        unnecessarily increase offset credit prices by rejecting many truly additional projects. While overly  
14        lenient tests may submerge the market with BAU credits and depress prices, thereby driving out activities  
16        with real public good benefits. The overall goal of additionality determinations is to screen out free-riders  
18        from receiving credits.

20        The key question, as noted by Trexler et al. (2006) is whether the incremental revenue from the sale  
22        of offset credits is a “decisive reason (although not necessarily the only reason)” for the project activity.  
24        They go on to explain that additionality is determined by asking “holding everything else constant, would  
26        an [activity have occurred] in the absence of the offset crediting mechanism.”<sup>20</sup>

28        One of the difficulties with the concept of additionality is that it is judged against a counterfactual. It  
30        is not known what would have been done in the absence of the offset credit revenue.<sup>21</sup>

## 32        **5.2 Testing RECs for additionality**

34        It is unnecessary for quota instruments to demonstrate additionality relative to a BAU scenario if  
36        they are used to meet a quota requirement.<sup>22</sup> Quota instruments are typically denoted in terms of an  
38        absolute level of an activity because the scarcity created by the overall quota ensures that the policy  
40        creates behavior change. However, voluntary markets that trade instruments claiming to produce  
42        quantified behavior changes, are implicitly claiming to be trading in offset credit instruments. And it is  
44        necessary to have some procedure to determine the additionality of projects that are awarded offset  
46        credits. If the argument made by REC marketers is that the revenue from the sale of RECs “caused” a  
48        public good to be produced, then additionality tests determine the credibility of this causation claim. So,  
50        do RECs sales in U.S. voluntary green power markets lead to additional electricity generation from  
52        renewable sources relative to BAU? It should not be taken as a given that voluntarily buying green power  
54        or RECs will increase the amount of renewable electricity generated or decrease the amount of non-  
56        renewable energy generated.

58        Why should we care about the additionality of RECs? The concern is that in a system that ignores  
60        additionality, BAU projects will dominate the market. Truly additional projects that result in  
62        environmental improvements beyond BAU will not be able to compete in the marketplace because they  
64        face additional costs or barriers. In such a market, there are two losers: the public good and well-  
66        intentioned project developers. Eventually, these environmental markets will collapse due to lack of  
68        credibility with the public.

70        There is no single test to objectively determine the additionality of all types of project activities.  
72        Therefore, it is typical to rely on a combination of tests.<sup>23</sup> A variety of different types of additionality tests  
74        has been applied to offset crediting schemes (Table 2). Trexler and Kosloff (2006) state that RECs are not

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<sup>20</sup> The concept of additionality has an ethical dimension, especially in voluntary markets. Implicitly, it assumes that the entity selling offsets has no ethical obligation to reduce emissions, and instead should be paid to do so.

<sup>21</sup> There may be some relatively unambiguous examples of additional activities. These activities would provide public good benefits, have no source of revenue besides offset credits, and be unaddressed by regulations or other obligations or standards.

<sup>22</sup> The eligibility requirements for RECs under a few state RPS requirements do include weak additionality tests. However, there is no need to burden a quota-based trading system with the transaction costs associated with additionality tests. It is only under an open, or uncapped, system that a determination of additionality is necessary.

<sup>23</sup> It is important to note that despite the calls for consumers to educate themselves about the quality and additionality of the RECs and GHG offset credits they purchase, it is both impractical and inefficient for individual consumers to make these evaluations. Consumers have limited access to information and limited capacity to interpret this information. Evaluations are better made through the application of common commodity standards, ideally including some government oversight.

subject to any additionality tests. However, voluntary market RECs certified under the major NGO standards do pass some additionality tests (Table 2). However, these tests, compared to those typically applied to GHG offset crediting projects, are the weakest of those available and do little more than screen out the most patently non-additional projects.

Table 2

Types of additionality tests and their application to GHG offset credits and U.S. voluntary REC markets<sup>24</sup>

Type*	Description*	Stringency	Applied to GHG offsets <sup>25</sup>	Applied to RECs <sup>26</sup>
Regulatory	The project activity is not required by government regulations or commonly accepted industry standards. Behavior change from the project activity must exceed that required or implied by regulations or standards.	Typically weak. Also depends on level of regulatory enforcement.	✓	✓ Cannot be counted toward RPS compliance (weak)
Technology	Specific technologies are predetermined to be additional or eligible.	Can be weak or strong depending on technology and support mechanisms	(varies)	✓ Eligible renewable technologies (weak)
Financial	The project activity would have a lower than acceptable financial return without the revenue from the sale of offset credits.	Typically strong.	✓	
Barriers	A project activity must face significant implementation barriers (e.g., lack of local infrastructure) that the revenue or other assistance provided through the sale of offset credits allows the project to overcome.	Can be weak or strong. Difficult to objectively assess.	✓	
Common practice	The project activity must utilize technologies or practices that are not in common use within a particular jurisdiction or industry.	Can be weak or strong. Easier to analyze where data on industry practices available.	✓	
Initiation date	The project activity must be initiated by a certain date. Projects started earlier than this date are deemed non-additional.	Weak	✓	✓ Began operation after 1996
Performance benchmark	The project activity must perform at a rate (e.g., per MWh of electricity generated) that is lower than some industry or technology benchmark.	Can be weak or strong. Requires extensive methodological development.	(varies) <sup>27</sup>	

\* Types and descriptions modified from (Trexler et al., 2006).

<sup>24</sup> Whether a project is determined additional is also a function of time. For example, an activity that is not common practice today may be next year. Additionality standards are typically updated in conjunction with a crediting period. Project developers need warning about updates to additionality standards to avoid stranded investments.

<sup>25</sup> Primarily based on Clean Development Mechanism (CDM) (UNFCCC, 2006).

<sup>26</sup> Based on U.S. NGO certification standards (CRS, 2006; ERT, 2006). Again, not all voluntary market RECs are certified.

<sup>27</sup> The Australian National Emissions Trading Scheme is developing performance benchmarks and model projects to determine additionality for sub-sectors (Fowler, 2007).

2  
4 The two major REC certification schemes cover a large portion of the market, and both apply nearly  
6 identical additional tests.<sup>28</sup> The *regulatory additionality test* applied to certified voluntary market RECs is  
8 typically that the same renewable generation must not be counted toward RPS compliance. The  
*technology test* is simply that electricity is generated from an eligible renewable energy technology (e.g.,  
wind, solar, or geothermal). The *initiation date test* is formulated such that all generation capacity  
installed since the early days of the voluntary green power market is eligible.

10 In combination, these tests assume that all renewable energy generation capacity not counted  
12 towards an RPS and built after 1996 would not have been constructed without revenue from REC sales  
into the voluntary market. To determine whether this assumption is adequate for screening out most free-  
riders, we must consider the economics of renewable energy generation, investments, and REC markets.

### 14 **5.3 Economics of renewable investment and additionality**

16 Electricity generation technologies that use wind, solar, and geothermal operate with near zero  
18 variable operating costs.<sup>29</sup> Once constructed, renewable generation units always run, assuming  
20 availability (e.g., wind is blowing and unit is operational) because revenue can be earned from generating  
22 electricity without incurring variable costs. The additional revenue supplied to a renewable generator  
from REC sales is unlikely to affect the dispatch or quantity of electricity produced by these existing  
renewable generation facility. Therefore, the additionality of RECs must be determined when a decision  
whether to invest in renewable generation capacity is made. Projects shown to have been started with the  
expectation and need for REC revenues are likely to be additional.<sup>30</sup>

24 Renewable energy investment decisions are affected by a variety of financial considerations. Overall,  
26 investors need a minimum amount of revenue per MWh to recover their initial capital investment. In the  
United States wind generators need a fairly predictable revenue stream of at least \$70 to 80/MWh, while  
solar photovoltaic requires roughly \$210/MWh (EIA, 2006a). Wholesale electricity prices paid to  
generators, including renewable generators, in the United States ranged of from \$37 to \$64/MWh, with a  
national average of \$51/MWh in 2005 (EIA, 2006b).

28 In addition to revenue from wholesale electricity sales, renewable generators may also receive  
30 government support. Many countries, as well as some states and localities, provide incentives for  
renewable energy investments such as guaranteed feed-in-tariffs, exemption from property taxes,  
accelerated depreciation option, and tax credits. In the United States, the Production Tax Credit for new  
wind generation capacity currently provides \$19/MWh for 10 years.<sup>31</sup> In some cases, subsidies and other  
incentives make renewable generation investments economical.

34 Renewable generators may also sell RECs into RPS compliance or voluntary green power market as  
36 an additional source of income. REC prices in RPS compliance markets vary widely and are primarily a  
function of the stringency of the quota mandated by the RPS.

38 REC prices in voluntary markets vary by resource type (e.g., biomass, wind, and solar) (Holt and  
Bird, 2005) and region (Hathaway, 2007), with solar selling for a premium above the others. Wholesale  
REC prices in the U.S. voluntary market range from \$0.5 to \$10/MWh, with a typical price around

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<sup>28</sup> Not all RECs sold into voluntary green power markets are certified under these standards. It is likely that these  
uncertified RECs are not subject to any additionality tests. For a list of REC products and marketers see  
<http://www.eere.energy.gov/greenpower/markets/certificates.shtml>

<sup>29</sup> Biomass may have fuel costs, although these should be low, especially if the biomass is a waste product. Wind  
typically accounts for the largest portion of renewable generation supplying REC markets.

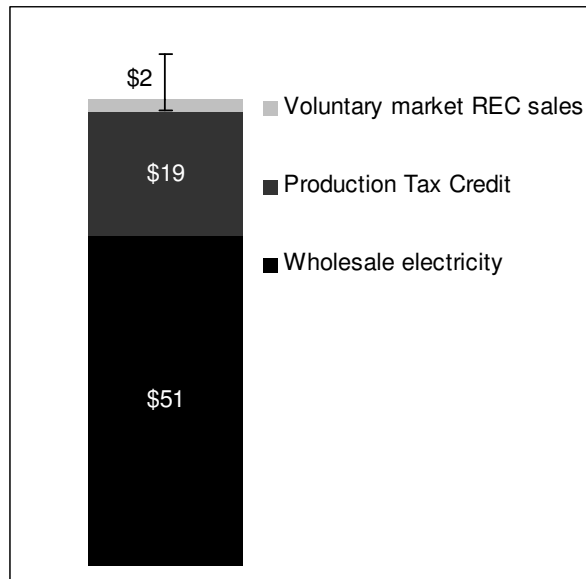
<sup>30</sup> Although common in voluntary REC markets, insisting on the purchase of current vintage year RECs does  
nothing to address the issue of additionality. Additionality is independent of when electricity is generated.  
Prohibiting banking of RECs or offset credits from renewable energy projects will also do nothing to address  
additionality.

<sup>31</sup> The Production Tax Credit covers the entire output of a wind generator and is adjusted for inflation. However, it  
regularly expires and must be renewed by Congress.

\$2/MWh (Bird and Swezey, 2006; Hathaway, 2007). Solar RECs may sell for significantly more, as customers exhibit a higher willingness to pay for solar (Borchers et al., 2007).

The wholesale price of RECs represents the gross income from certificate sales. There may be certification and/or broker fees involved in a REC transaction. Typically, certification and brokerage costs separately range from 3 to 5 percent (e.g., \$0.05 to 0.15/MWh) (Hathaway, 2007). At current prices, the net income from REC sales for wind generator accounts for roughly 1 to 10 percent of total project revenue (Figure 1). For solar, income from RECs can more than double revenues.

Figure 1  
Typical revenue streams for a U.S. wind power generator (\$/MWh)\*



\* Average U.S. whole sale electricity price data from (EIA, 2006b). Typical wholesale REC prices from (Bird and Swezey, 2006; Hathaway, 2007). Error bars for voluntary market REC sales indicate typical range of prices.

The retail prices for RECs are often significantly higher than wholesale prices, reflecting marketing costs and profit margins. Retail REC prices for residential and small commercial customers range from \$15 to \$30/MWh, although for solar they may be as high as \$100 to \$200/MWh (Bird and Swezey, 2006; Hathaway, 2007). Large commercial and industrial customers are often able to negotiate lower prices.

It is widely recognized that it is essential to procure long-term purchase contracts to make the financing of renewable generation capacity economical (Agnolucci, 2007; Baratoff et al., 2007; Holt and Bird, 2005). The additionality of renewable energy projects is therefore affected by the ability of investors to secure long-term contracts for REC sales. Holt and Bird (2005) note that a problem with the voluntary REC markets is that they often do not provide sufficient income certainty to alter investment decisions.

Most renewable energy projects in the United States are implemented without financial consideration of any revenue from RECs, and therefore are not additional. What revenue is obtained from RECs is severely discounted by investors, unless a long-term contract for REC sales can be obtained (Baratoff et al., 2007). Such long-term contracts can be obtained in some RPS compliance markets, but are much less common in voluntary REC markets. For a voluntary REC market to influence the decisions of renewable energy investors in the United States, it is necessary for customers to be willing to make a long-term commitment to purchase RECs.

#### 5.4 The importance of scarcity

In determining the additionality of RECs it is also helpful to identify when a REC market is long. A market is long when the demand for RECs is less than the BAU supply. The BAU supply is how many RECs are awarded to non-additional renewable energy projects (i.e., false positives). A long market is more likely to exist where the process for determining the additionality of renewable energy projects for the REC market is grossly insufficient at screening out free-riding projects.

Both RPS compliance and voluntary REC markets can be long. However, it is more likely that a RPS compliance market, with its defined participation boundaries, will exhibit a market scarcity due to the ability of government to set a mandatory quota for RECs.

How do you determine whether a REC market is long? One approach is to look at prices. If wholesale REC prices are not significantly above the level of transaction costs in the market, then it implies that the market is long and BAU projects have not been adequately screened out.<sup>32</sup>

Figure 2 presents an idealized supply-demand curve for a voluntary REC market. The supply line ( $S$ ) is discontinuous because RECs are not the only source of revenue for renewable energy generators. There is a supply of RECs on the market that result from projects that are implemented with consideration of the revenue from REC sales.

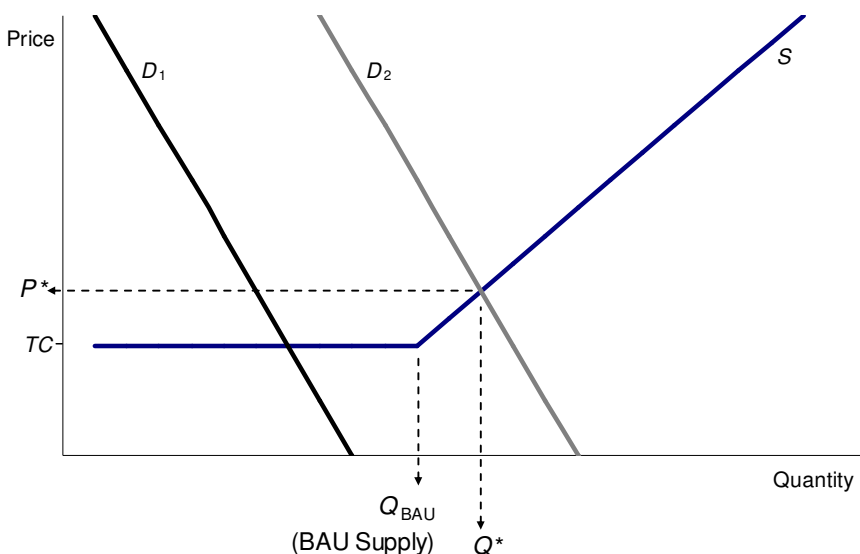


Figure 2  
Idealized supply-demand curves for a voluntary REC market.

Two demand scenarios are presented in Figure 2. Demand scenario 1 ( $D_1$ ) illustrates a case where the voluntary market demand for RECs is less than the amount supplied by BAU projects and the REC market is long. The wholesale price of these RECs is equivalent to transaction costs ( $TC$ ). Renewable generators face transaction costs, including certification and brokerage fees (Table 3). A wholesale REC price of at least \$0.5/MWh is likely necessary to cover these transaction costs. Therefore, a long REC market will not present a price of zero for RECs. Under demand scenario 1, the voluntary REC market has no effect on the supply of renewable energy generation or capacity and no additional environmental

<sup>32</sup> Another approach would be to investigate whether there is a significant number of renewable energy generators that are eligible, but do not sell RECs into the market. Some small renewable generators in the United States do not sell RECs into the voluntary market (Hathaway, 2007).

benefits are created. The second demand scenario ( $D_2$ ) does create a scarcity and the market does have a marginal effect on renewable energy investments. Under this second scenario, wholesale REC prices trade at a price of  $P^*$ , which is above the level of transaction costs.

Table 3  
Generic supply and demand characteristics of REC markets.

Demand scenario	Marginal cost of REC supply	Generator response	REC price determinant
$D_1$ (Long market)	0	The demand for RECs is less than the BAU supply that would be produced anyway.	Prices are roughly equal to transaction costs. Prices are mostly unaffected by changes in demand below the BAU supply.
$D_2$ (Market scarcity)	Positive	Additional generation capacity with lowest marginal cost will be brought online to meet demand above BAU.	Marginal cost of generating additional MWhs of renewable electricity above BAU demand plus transaction costs.

It is important to recognize that even if a voluntary REC market exhibits a scarcity for RECs, not all of the RECs sold in that market are necessarily from additional renewable energy projects. There can still be an excessive number of free-riders that have not been screened out of the market. It may simply be that consumer demand exceeds the BAU supply of RECs in the market. In this case, the incremental effect on renewable energy investments caused by the voluntary REC market is not equivalent to the total number of RECs sold in the market. The incremental effect is instead equal to the total demand for RECs minus the BAU supply ( $Q^* - Q_{BAU}$ ). If RECs sold in voluntary markets do not pass credible additionality tests, then they can at best be expected to have a marginal effect that is less than the total number of RECs sold.

It is, therefore, inaccurate to assume that RECs represent additional megawatt-hours of renewable energy generation because of a market demand effect. Even if there was such an effect—because the voluntary market demand was greater than the BAU supply—many RECs would still be sold to customers from non-additional projects because of inadequate additionality tests. Such additionality tests are best applied at an individual project level, instead of for the market as a whole. Projects have clearly defined boundaries (e.g., a power plant facility or collection of proximate wind turbines). As the boundaries of an activity enlarge, monitoring becomes increasingly difficult, determining additionality becomes more complex, and assigning ownership of the marginal impact of the credit market to multiple project investors becomes difficult.

So, is the demand for RECs in voluntary markets greater than the BAU supply? Additional research is needed to answer this question more definitively, but an examination of actual prices in the U.S. voluntary REC market gives us a hint of what the answer is likely to be. REC prices in the U.S. voluntary market are quite low, as shown above, and do not appear to be significantly above the level of transaction costs. More importantly, the evidence available indicates that voluntary market REC sales, at least for most renewable energy sources (e.g., non-solar) do not factor into investor calculations. The revenue stream is too small, and it is too uncertain (Baratoff et al., 2007).

### 5.5 Voluntary and RPS compliance market interactions

Consumers may have the option of purchasing and retiring RECs that are eligible for use in RPS compliance markets. Doing so reduces the supply of RECs available to LSEs to meet their quotas. If an RPS target does not produce a real scarcity (i.e., the compliance REC market is long) then voluntarily removing a REC from the market will have no effect on renewable energy investments or generation. Voluntarily removing RECs from a RPS compliance market with a stringent quota, however, is an effective tactic to ensure the additionality of RECs. The act of retiring and removing RECs from the compliance market, in this case, determines additionality. When an RPS creates a REC market scarcity and a REC is retired so that it cannot be used for compliance by LSEs, then a renewable generator will have to produce an additional REC to supply the fixed market demand. Retiring RECs and other

environmental commodities from RPS compliance markets avoids the need to conduct project-by-project additionality determinations.

Like voluntary REC markets, whether a RPS compliance market is long can be evaluated based on REC wholesale prices. REC prices in these markets vary with the stringency of the RPS target and by technology type. Wholesale REC prices in RPS compliance markets range from \$2/MWh to over \$200/MWh for solar RECs in New Jersey. A relatively clear indication that an RPS market is not long is when REC prices are at or near the penalty fee for non-compliance (Agnolucci, 2007).

## 5.6 Summary

Because of the weak additionality tests applied, RECs sold in voluntary markets are more accurately regarded as a production subsidy for renewable electricity generation. A determination of additionality distinguishes between projects that would have occurred without the subsidy from those that would not. But the voluntary REC market does not adequately make this distinction.

In contrast to the typical definition of a subsidy<sup>33</sup>, in the voluntary REC market it is the consumer, not the government, which fills the role of subsidy provider. Financial contributions provided by the public in support of a public good, are typically referred to as charity. The use of RECs as an accounting instrument, though, allows consumers to collectively offer renewable generators a production subsidy for each MWh they generate.

The impact of a production subsidy is on the margin of the market (Figure 2). The subsidy makes a certain amount of production economical that was not in the absence of the subsidy. In the language of environmental markets, we would say that it is this marginal increase in production resulting from the subsidy that is additional to BAU. However, voluntary markets cannot guarantee the subsidy to all eligible recipients. When available supply of a production subsidy (i.e., consumer demand) is less than the BAU supply of the subsidized product or service by producers and the subsidy price is determined by the market, then the subsidy will have a negligible effect on production.

It is not clear how significant an impact the voluntary REC market has had on renewable investment decisions. Overall, though, there appears to be little evidence that the voluntary REC market in the United States is a deciding factor in renewable energy generators' decision to invest in new capacity. Because of the weak additionality tests applied and low wholesale REC prices, it is safe to assume that most RECs sold in voluntary markets are not additional (i.e., false positives are prevalent). The exception is solar, which typically benefits from higher REC prices.

The primary drivers for new capacity investments in the United States and Europe are government subsidies (Baratoff et al., 2007; Bird et al., 2003; Heiman, 2006; RECS, 2005). However, in other jurisdictions where renewable technologies do not receive financial support from the government, renewable energy projects are more likely to be additional and the revenue from RECs sales may be a deciding factor for investors.

## 6 If additional, are RECs equivalent to emission offset credits?

There has been much confusion regarding the effect of RECs on emissions since the emergence of REC markets (Sloan, 2001). Again, the central problem is that RECs are assumed to be an emission offset credit instrument.<sup>34</sup> Can an entity credibly claim to have offset GHG emissions by purchasing and retiring RECs? More specifically, can an entity purchase and retire RECs and then claim rights over emission reduction offset credits or claim to have offset its emissions from electricity consumption? The real

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<sup>33</sup> A subsidy is typically defined as financial assistance from the government that encourages the production or purchase of a good or service.

<sup>34</sup> In their Staples case study, the World Resources Institute states that Staples' REC purchases "resulted in an additional 35,000 metric tons of avoided GHG emissions." Clearly the author is equating RECs with offset credits (Pino, 2006). This type of claim is commonplace in voluntary REC markets in the United States. See also TerraPass ([www.terrapass.com](http://www.terrapass.com)) and Green-e ([www.green-e.org](http://www.green-e.org)).



question in both formulations is whether less is emitted from grid-connected electricity generation due to the purchase and retirement of RECs.

Electricity is a major source of energy for most consumers. Voluntary green power and GHG offset markets both lack standardized commodities or regulation, which results in a great deal of confusion on the part of consumers wishing to offset emission associated with their electricity consumption. Because RECs are typically less expensive than credible GHG offset credits, they are often favored for purchase by those unable to distinguish between the two types of environmental commodities. The difference in price, however, is largely due to the difference in the additionality of RECs and GHG offset credits. For example, CDM offset credits (i.e., Certified Emission Reductions) trade on the market for around \$20/metric ton CO<sub>2</sub>. In contrast, RECs in the U.S. voluntary market can be purchased wholesale for around \$2/MWh. Conservatively assuming that a MWh of renewable electricity did displace electricity from a coal-fired power plant, which emits 1 metric ton/MWh, then the retirement of one REC would offset about one metric ton of CO<sub>2</sub> for a price of \$2/metric ton CO<sub>2</sub>. Many consumers wish to contribute to the fight against global warming, but they also want to do it as cheaply as possible, especially if they cannot evaluate the claims made by marketers of RECs.

Treating RECs as being equivalent to offset credits is analogous to assuming that none of the electricity associated with RECs would have been generated without the additional income from the sale of RECs. Given that many or most RECs sold in voluntary markets are *not additional*, then this assumption is clearly false. A non-additional REC cannot result in additional emission reductions.

If a consumer was able to procure RECs from a renewable energy project that was determined to be additional (i.e., strong additionality tests were applied), then treating RECs as emission offsets still presents two more problems. The first is resolving ownership issues. The ownership of RECs themselves has at times been contested (Holt and Bird, 2005; Holt et al., 2006). The more important issue, though, relates to ownership claims over emission reductions that occur off-site from the renewable energy facility. The second problem relates to the difficulty in quantifying the effect that renewable energy generation has on the dispatch of grid-connected fossil fuel-fired generation as well as the effect that REC markets have on renewable generation.

## 6.1 Ownership

Before discussing ownership issues related to emission reduction claims made in REC markets, it is necessary to introduce the concept of direct and indirect emissions (WRI/WBCSD, 2004, 2005). Direct emissions are those that occur on the site of the renewable energy facility, while indirect emissions are those that occur off-site.

Although most renewable energy projects will not be associated with significant direct emissions, some may. For example, landfill gas methane may be used as a biofuel to generate electricity. Such projects may produce direct emissions reductions by combusting previously vented methane that are additional to BAU. The ownership of these emission reductions are relatively unambiguous (i.e., belong to parties invested in the project).

The more central issue for RECs relates to ownership claims over indirect emissions from the consumption of electricity (i.e., GHG Protocol Scope 2) and indirect emission reductions assumed to occur at a fossil fuel-fired power plant because electricity was instead generated by a renewable technology.<sup>35</sup> Due to the complex operations of the electric power grid, it is difficult to establish unambiguous causal linkages between renewable energy generation and changes in generation at other power plants on the grid. Since most of the benefits associated with renewable generation result from changes in behavior at off-site facilities that are under the control of other entities (e.g., at fossil fuel-fired power plants), ownership of benefits is ambiguous.

It is also ambiguous whether entities wishing to offset their emissions should claim responsibility for the indirect emissions associated with their electricity consumption, since these emissions occur at fossil

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<sup>35</sup> Indirect emissions from electricity consumption are referred to as Scope 2 emissions under the World Resource Institute / World Business Council for Sustainable Development GHG Protocol (WRI/WBCSD, 2004).

2 fuel-fired power plants. Although regulatory liability to mitigate GHG emissions is more likely to be  
placed on power plants that emit rather than on end-users of electricity, it is clear that electricity demand  
4 is a proximate cause of GHG emissions. Many entity-level emission accounting protocols have accepted  
the use of RECs and green power purchases to offset indirect emissions from an entity's electricity  
6 consumption. Their argument is seductive because it seems logical that the purchase of green power  
should offset indirect emissions resulting from electricity consumption. We can all agree that renewable  
8 energy does not emit pollution; however, this fact does not allow us to conclude that the sale of RECs  
caused additional renewable energy to be generated.

10 The argument that RECs can be used as emission offsets for Scope 2 emissions implicitly claims that  
the offsetting of indirect emissions should be held to a lower standard of credibility than claims regarding  
the offsetting of direct emissions. It is reasonable to debate whether emissions from electricity generation  
12 are the responsibility of electricity consumers or generators. However, if consumers decide to claim  
responsibility for indirect emissions associated with their electricity consumption, then they should apply  
14 credible emission offsets to them. Ambiguity regarding the ownership of the emissions from electricity  
generation does not justify ignoring the additionality, ownership, and quantification characteristics of  
16 credits used to offset them. To claim that RECs or green power purchases offset indirect emissions from  
electricity consumption is equivalent to claiming that the generation of renewable energy is inherently  
18 additional and equivalent to an offset credit. As shown above, such a claim is not justified.<sup>36</sup>

20 With ownership issues it is also important to distinguish between legal property rights and customary  
rights to make marketing claims. It is common to find advocates of voluntary REC markets making  
statements such as "If a company can claim ownership of a REC it can also claim the environmental  
22 benefits of the associated green power" (Pino, 2006). However, in the United States and Europe a legal  
basis for holders of RECs to make property rights claims over indirect GHG emissions or emission  
24 reductions (i.e., government-sanctioned emission allowances or offset credits) has not been  
demonstrated.<sup>37,38</sup>

26 By equating RECs with emission offsets, consumers are attempting to claim ownership of a public  
good (e.g., reduced pollution) or set of public goods (e.g., all environmental benefits). In doing so, they  
28 are attempting to make a non-excludable public good (e.g., emissions reduced through generating  
electricity from renewable sources) excludable (i.e., a private good). Typically, only governments are  
30 thought of as being capable of assigning property rights over public goods. In voluntary markets, entities  
can only attempt to exclude others from marketing claims regarding the same public good. Ownership  
32 claims by participants in voluntary REC markets are (or should be) restricted to marketing claims.

34 REC and certificate registries are being established in many states, regions, and countries to facilitate  
REC markets and deal with ownership and double counting issues (Wingate and Holt, 2004). Although  
these tracking systems will address double counting issues with certificates, they do not address  
36 ownership issues with emission reductions or other environmental benefits.<sup>39</sup>

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<sup>36</sup> An instructive mental exercise is to imagine a world in which BAU is that 50 MWh of electricity is generated from renewable energy and 50 MWh from non-renewables. Then a green power market develops and some consumers purchase 50 RECs. These consumers then claim to have offset their indirect emissions from electricity. From the perspective of the atmosphere, however, the amount of pollution emitted has not changed. The renewable/non-renewable mix of generation is the same. And it is unlikely that the customers not purchasing RECs are now claiming that their electricity is now more polluting.

<sup>37</sup> In countries eligible for CDM projects, renewable energy projects may be able to claim property rights over offset credits because fossil fuel power plants in most developing countries are not currently under the threat of emission caps.

<sup>38</sup> For a case describing the allocation of NO<sub>x</sub> allowances to entities for their purchase of RECs, see (Jacobson, 2007).

<sup>39</sup> None of the certificate tracking systems in the United States or Europe track off-site attributes of renewable generation. Massachusetts as attempted to do so by assigning a monthly average emission rate for the grid to certificates with the assumption that it is equivalent to avoided emissions.

## 6.2 Quantification

2 Quantifying the number of MWh produced by a renewable energy project is not problematic, as  
meter quality data is typically available. However, the quantification of environmental benefits (e.g.,  
4 emission reductions) that may be produced off-site from the renewable generation facility is problematic.

6 It is not feasible to track electrons through the electric transmission and distribution grid. Therefore,  
the effect of an input of electricity from a renewable generator on other grid-connected generators is  
difficult to quantify. Emissions trading is typically prefaced with the assumption that it does not matter  
8 where or when emissions occur. In the case of renewable energy generation's displacement of fossil  
generation, where and when the generation occurs matters a great deal. GHG offset crediting  
10 methodologies under the CDM recognize this issue and utilize quantification methods that approximate  
the relevant marginal emissions from generators supplying the local electrical grid.<sup>40</sup> In contrast,  
12 marketers that claim RECs are equivalent to GHG emission offset credits typically apply a simple grid  
average emission rate.

14 If REC additionality claims are based on incremental renewable investments caused by purchasing  
RECs in a market exhibiting some scarcity (i.e., the claim is based on the marginal increase in renewable  
16 electricity generation produced by the voluntary REC market's production subsidy effect) then the  
magnitude of this incremental investment must be quantified. The difficulty of performing this type of  
18 market analysis and then allocating emission reductions to individual renewable generators is one reason  
that additionality is best determined, and offset credits are best awarded, to individual projects.

## 7 Discussion and conclusion

20 Environmental markets for renewable energy and emission offset commodities are currently in a  
22 state of confusion. Consumers are not clear what they are getting when they purchase RECs. The  
promotion of renewable energy markets is a reasonable approach to increase the supply of a variety of  
24 public goods. However, because of the economics of most renewable generation technologies, policies  
and voluntary markets should focus on the promotion of additional investment in renewable generation  
26 capacity above BAU levels. Financial contributions to existing renewable capacity are unlikely to result  
in the supply of additional public goods.<sup>41</sup>

28 Are consumers that voluntarily purchase and retire RECs buying green power? Because RECs are an  
intangible market instrument, unbundled from the actual commodity being sold (i.e., electricity), this is  
30 the wrong question to ask. RECs provide only a small portion of most renewable generator's revenue. The  
sale of RECs only has an impact on the production of electricity from renewable generators if RECs can  
32 be sold at sufficiently high prices under long-term contracts. A more appropriate question is: Did  
purchasing a REC cause renewable electricity to be generated and delivered to the grid instead of  
34 electricity from some non-renewable energy source? Because renewables have minimal operating costs,  
the revenue from REC sales will not affect decisions to operate or dispatch renewable generation. For  
36 RECs to be considered to come from additional project, the revenue from certificate sales needed to have  
caused investments in additional renewable generation capacity. Without credible additionality tests, the  
38 sale of RECs in voluntary markets can at best be expected to have a market demand effect that will be less  
than the supply of RECs on the market.

40 It was found that RECs are not equivalent to emission offsets and the retiring of a REC may have no  
impact on emissions from electric power generation. Instead, consumers that purchase RECs in voluntary  
42 markets are providing financial assistance to renewable generators in the form of a production subsidy.  
Generators that sell RECs are, also, not transferring property rights to emission reductions, since they are  
44 unlikely to have ownership or the ability to quantify reductions using a commonly accepted standard.

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<sup>40</sup> For an example of marginal dispatch substantiation of emission reductions see (RSG, 2006). It is important to  
note, however, that this type of analysis can become overly complex and indeterminate when the marginal effect of  
multiple renewable energy generators is analyzed simultaneously.

<sup>41</sup> Unless the original investment was made with the need and assumption of revenue from certificate sales.

2 Consumers that wish to make claims that they are displacing non-renewable generation can purchase  
3 RECs from a RPS compliance scheme that has created a market scarcity.

4 The error in the belief that RECs are equivalent to emission offset credits partly lies with the use of  
5 the term “environmental attribute” or “environmental benefit.” Definitions using this type of language are  
6 almost universally ambiguous, give consumers the mistaken impression that they are purchasing a good  
7 instead of subsidizing a public good, and prevent RECs from functioning as a homogeneous  
8 environmental commodity.

9 There is much confusion regarding the issue of RECs and GHG emission reductions, in part because  
10 of the ownership and quantification issues regarding an entity’s emissions from electricity consumption  
11 (i.e., Scope 2 emissions) that it wishes to offset. An entity’s decision regarding its responsibility for  
12 emissions from its electricity consumption, however, should be separated from requirements for the  
13 credibility of emission offset credits applied to them. If the goal is to reduce GHG emissions, then first  
14 best measures (i.e., GHG emission offsets) are the appropriate instrument. Evaluating the quality of  
15 voluntary market GHG offset credits, especially the additionality of projects, is an issue, however, that  
16 requires its own careful attention (Akerlof, 1970; Kollmuss, 2006; Trexler, 2006; Trexler and Kosloff,  
2006).<sup>42</sup>

17 These conclusions should not be taken to mean that renewable energy projects cannot be awarded  
18 emission offset credits. But they do mean that offset credits from renewable energy projects should be  
19 based on project-level accounting process that fully addresses additionality, ownership, and quantification  
20 issues.

21 Having addressed the relationship between RECs and emission offset credits in this paper (Part 1),  
22 the relationship between RECs and emission markets more generally is provided in Gillenwater (2007).  
23 Specifically, this Part 2 paper explores the relationship between RECs and emission allowances used in  
24 GHG emissions cap-and-trade schemes.

## 25 **Acknowledgements**

26 The author would like to acknowledge Tom Kreutz, Clare Breidenich, Alden Hathaway, Jasmine  
27 Hyman, Michael Oppenheimer, Derik Broekhoff, Randy Udall, V.C. Patel and several other anonymous  
28 reviewers for their useful comments. The author is solely responsible for the views expressed.

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<sup>42</sup> The United Kingdom has recently drafted a code of best practices for the voluntary GHG offset credit market. The code limits the market to obtaining reductions from CDM CERs, Joint Implementation ERUs, and EU-ETS allowances. The code excludes voluntary emission reductions (VERs) because of their lack of standardization and verification. They do not acknowledge problems resulting from the over-allocation of allowances in the first phase of the EU-ETS, which makes the additionality of retiring these allowances questionable.

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## Appendix A – REC and environmental attribute definitions

2 Table 4  
Definitions of a REC and “environmental attributes” for select RPS compliance and voluntary REC markets (as of end of 2006)

Reference	Definitions
<i>State RPSs</i>	
Texas <sup>43</sup>	“A REC represents one megawatt hour of renewable energy that is physically metered and verified in Texas and is generated by a facility eligible for producing RECs.” Eligible facility must be either less than 2 MW in size or placed into service after 1 September 1999.
California <sup>44,45</sup>	<p>“Renewable energy credit means a certificate of proof, issued through the accounting system established by the Energy Commission pursuant to Section 399.13, that one unit of electricity was generated and delivered by an eligible renewable energy resource.”</p> <p>“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 40709 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.”</p> <p>“Environmental Attributes means any and all credits, benefits, emissions reductions, offsets, and allowances, howsoever entitled, attributable to the generation from the Unit(s), and its displacement of conventional energy generation. Environmental Attributes include but are not limited to: (1) any avoided emissions of pollutants to the air, soil or water such as sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO) and other pollutants; (2) any avoided emissions of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and other greenhouse gases (GHGs)...; and (3) the reporting rights to these avoided emissions such as Green Tag Reporting Rights. Green Tag Reporting Rights are the right of a Green Tag Purchaser to report the ownership of accumulated Green Tags in compliance with federal or state law, if applicable, and to a federal or state agency or any other party at the Green Tag Purchaser’s discretion, and include without limitation those Green Tag Reporting Rights accruing under Section 1605(b) of The Energy Policy Act of 1992 and any present or future federal, state, or local law, regulation or bill, and international or foreign emissions trading program... [One] Green Tag represents the Environmental Attributes associated with one (1) MWh of energy. Environmental Attributes do not include (i) any energy, capacity, reliability or other power attributes from the Unit(s), (ii) production tax credits associated with the construction or operation of the energy projects and other financial incentives in the form of credits, reductions, or allowances associated with the project that are applicable to a state or federal income taxation obligation, (iii) fuel-related subsidies or “tipping fees” that may be paid to Seller to accept certain fuels, or local subsidies received by the generator for the destruction of particular pre-existing pollutants or the promotion of local environmental benefits, or (iv) emission reduction credits encumbered or used by the Unit(s) for compliance with local, state, or federal operating and/or air quality permits. If Seller’s Unit(s) is a biomass or landfill gas facility and Seller receives any tradable Environmental Attributes based on the greenhouse gas reduction benefits or other emission offsets attributed to its fuel usage, it shall provide Buyer with sufficient Environmental Attributes to ensure that there are zero net emissions associated with the production of electricity from such facility.”</p>

<sup>43</sup> Chapter 25. Substantive Rules Applicable to Electric Service Providers; Subchapter H. Electrical Planning; Division 1. Renewable Energy Resources and Use of Natural Gas.

<sup>44</sup> California Public Utilities Code, Section 399.11-399.20

<sup>45</sup> Opinion Adopting Standard Contract Terms and Conditions, Public Utilities Commission of the State of California, Decision 04-06-014, 9 June 2004. [/www.cpuc.ca.gov/PUBLISHED/Final\\_decision/37401.htm/](http://www.cpuc.ca.gov/PUBLISHED/Final_decision/37401.htm/)

New Mexico <sup>46</sup>	<p>“[A REC is a] document evidencing that the enumerated renewable energy kilowatt-hours have been generated from a renewable energy generating facility.”</p> <p>“Renewable energy certificates shall contain the following information: (1) the name and contact information of the renewable energy generating facility owner and/or operator; (2) the name and contact information of the public utility purchasing the renewable energy certificate; (3) the type of generator technology and fuel type; (4) the generating facility’s physical location, nameplate capacity in MW, location and ID number of revenue meter, and date of commencement of commercial generation; (5) the public utility to which the generating facility is interconnected; (6) the control area operator for the generating facility; and (7) the quantity in kWh and the date of the renewable energy certificate transaction.”</p>
Colorado <sup>47</sup>	<p>“Renewable Energy Credit means 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.”</p>
Massachusetts <sup>48</sup>	<p>Generation Attribute [is 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.”</p> <p>“Renewable Generation Attributes [are] documentation from the NEGIS administrator of the total electrical energy sales to End-Use Customers in the Compliance Year associated with Renewable Generation Attributes”</p>
Arizona <sup>49</sup>	<p>“If an Affected Utility trades or sells environmental pollution reduction credits or any other environmental attributes associated with kWh produced by an Eligible Renewable Energy Resource, the Affected Utility may not apply Renewable Energy Credits derived from that same kWh to satisfy the requirements of these rules.”</p>
Nevada <sup>50</sup>	<p>“Portfolio energy credit means a unit of credit which: equals 1 kWh of electricity generated or saved by a portfolio energy system or efficiency measure.”</p>
Montana <sup>51</sup>	<p>“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.”</p>
Maine <sup>52</sup>	<p>“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.”</p>
Delaware <sup>53</sup>	<p>“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.”</p>

<sup>46</sup> New Mexico Administrative Code; Title 17. Public Utilities and Utility Services; Chapter 9. Electric Services; Part 572. Renewable Energy for Electric Utilities

<sup>47</sup> Colorado, Code of Colorado Regulations 4 CCR 723-3

<sup>48</sup> 225 CMR 14.00 - Renewable Energy Portfolio Standard

<sup>49</sup> <http://images.edocket.azcc.gov/docketpdf/0000063561.pdf/>

<sup>50</sup> Revised Adopted Regulation of the Public Utilities Commission of Nevada; LCB File No. R167-05

<sup>51</sup> Montana Code 69-8-1003.

<sup>52</sup> Maine 65.407 Chapter 311- Eligible Resource Portfolio Requirement

<sup>53</sup> Delaware Public Service Commission, Rules and Procedures to Implement the Renewable Energy Portfolio Standard

New Jersey <sup>54</sup>	<p>“Renewable Energy Certificate 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.”</p> <p>“Attribute means a characteristic associated with electricity generated using a particular renewable fuel, 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.”</p>
Maryland <sup>55</sup>	<p>“Renewable energy credit means a credit equal to the generation attributes of 1 megawatt-hour of electricity... that is located: (1) in the PJM region or in a state that is adjacent to the PJM region; or (2) outside the area...but in a control area that is adjacent to the PJM region, if the electricity is delivered into the PJM region.”</p>
Pennsylvania <sup>56,57</sup>	<p>“Alternative Energy Credit [is a] tradable instrument that is used to establish, verify and monitor compliance with this act. A unit of credit shall equal one megawatt hour of electricity from an alternative energy source.”<sup>58</sup></p> <p>“[T]he Commission concludes that it has no authority to find that an alternative energy credit includes [environmental or emissions attributes]. Generators are of course free to include those attributes in their sales of alternative energy credits. They may also sell, assign or trade them separately. Our expectation is that the disposition of these emissions and environmental attributes will be governed by specific, contractual language, and that parties will not look to the Commission to resolve ownership disputes.”</p>
District of Columbia <sup>59</sup>	<p>“Renewable energy credit means a credit representing one megawatt-hour of electricity consumed within the PJM Interconnection region that is derived from a tier one renewable source or a tier two renewable source that is located: (A) In the PJM Interconnection region or in a state that is adjacent to the PJM Interconnection region; or (B) Outside the area described in subparagraph (A) of this paragraph but in a control area that is adjacent to the PJM Interconnection region, if the electricity is delivered into the PJM Interconnection region.”</p>
<b><i>Voluntary REC standards</i></b>	
Green-e® <sup>60</sup>	<p>“Green-e only certifies renewable energy products that are fully aggregated to the extent possible under law.”</p> <p>“Green-e certified MWhs (electricity or REC) must contain all the greenhouse gas emission reduction benefits, including carbon dioxide (CO<sub>2</sub>) reduction benefits, associated with the MWh of renewable electricity when it was generated.”</p> <p>“Emission reductions of capped and traded pollutants where allowances are not routinely assigned to renewable electricity generators, which include sulfur dioxide (SO<sub>2</sub>) nationally, mercury (Hg) nationally, and the oxides of nitrogen (NO<sub>x</sub>) regionally, are not required to be included in Green-e Certified renewable electricity or RECs.”</p>

<sup>54</sup> New Jersey Administrative Code Title 14. Board of Public Utilities; Chapter 8. Renewable Energy and Energy Efficiency; Subchapter 2. Renewable Portfolio Standards; N.J.A.C. 14:8-2.1 et seq. (2006)

<sup>55</sup> Code of Maryland; Public Utility Companies; Title 7. Gas, Electric, And Water Companies; Subtitle 7. Renewable Energy Portfolio Standard; Md. Public Utility Companies Code § 7-701 Et Seq. (2005)

<sup>56</sup> Pennsylvania Statutes Title 73. Trade and Commerce; Chapter 18f. Alternative Energy Portfolio Standards Act; 73 P.S. §1648.1 et seq. (2005)

<sup>57</sup> Pennsylvania Public Utility Commission, Implementation of the Alternative Energy, Docket No. L-00060180, Portfolio Standards Act of 2004

<sup>58</sup> Includes waste coal and coal mine methane.

<sup>59</sup> D.C. Code Title 34. Public Utilities; Subtitle III. Electricity; Chapter 14a. Renewable Energy Portfolio Standards; D.C. Code § 34-1431 et seq. (2006)

<sup>60</sup> Sponsored by the Center for Resource Solutions.

EcoPower® <sup>61</sup>	<p>“RECs are unbundled from and do not include or convey any property rights associated with direct emission reductions resulting from the generation of electricity from renewable energy sources. All current or future government granted emission allowances or reduction credits for air or other emissions (e.g., sulfur dioxide and NOx allowances under the U.S. EPA’s Acid Rain Program) are separate commodities, which may be sold or transferred apart from RECs. The initial allocation of any emission allowances or reduction credits is a function of government laws and regulations, and is not contractually affected by the transfer of RECs.”</p> <p>“Marketers of RECs may not claim RECs include ownership rights of current or future government granted emission allowances or reduction credits for air or other emissions. Such claims can not be substantiated from a legal perspective.”</p> <p>“RECs do transfer to the buyer any and all rights or claims to any indirect emission reductions that may have occurred due to the displacement of fossil-fueled electricity generation by renewable electricity generation. The magnitude of these indirect emission reductions are not quantified or certified with an REC.”</p>
ACORE/EMA <sup>62</sup>	<p>A REC is “a measure of the societal benefit attributes of renewable electricity.”</p> <p>The contract recognizes three general types of RECs: A standard REC, a specified REC<sup>63</sup>, and a basic REC. The standard REC includes all Environmental attributes, whether or not they have been verified or certified by a governing program. A basic REC represents solely the certification of the generation of electricity from a renewable energy source. And a specified REC includes only those environmental attributes that are specified in a contract (or may include all attributes not otherwise excluded).</p> <p>“Environmental Attribute means an aspect, claim, characteristic or benefit associated with the generation of a quantity of electricity by a Renewable Energy Facility, other than the electric energy produced, and that is capable of being measured, verified or calculated. An Environmental Attribute may include one or more of the following identified with a particular megawatt hour of generation by a Renewable Energy Facility designated prior to Delivery: the Renewable Energy Facility’s use of a particular Renewable Energy Source, avoided NO<sub>x</sub>, SO<sub>x</sub>, CO<sub>2</sub> or greenhouse gas emissions, avoided water use (but not water rights or other rights or credits obtained pursuant to requirements of Applicable Law in order to site and develop the Renewable Energy Facility itself) or as otherwise defined under an Applicable Program, or as agreed by the Parties. Environmental Attributes do not include production tax credits or other direct third-party subsidies for generation of electricity by any specified Renewable Energy Facility.”</p> <p>“A REC may include some or all additional Environmental Attributes associated with the generation of electricity, and those Environmental Attributes may, but need not be, Verified or Certified by the same or different Verification Authorities or Certification Authorities, and disaggregated and retained or sold separately, all as the Parties agree in a Product Order.”</p>
RECS International <sup>64</sup>	<p>European RECS certificate states that a REC represents “the entire benefit of [renewable energy based electricity] over electricity from non-renewable resources.”</p>
EC Renewable Energy Directive <sup>65</sup>	<p>A Guarantee of Origin specifies at least the following items: the amount of energy injected into the public grid, the character and maximum capacity of the facility, the generation period and generation place, the energy sources used for generation.</p>

<sup>61</sup> Sponsored by Environmental Resources Trust.

<sup>62</sup> <http://acore.org/programs/rectrading.php>

<sup>63</sup> There are actually two type of specified RECs. Positive specified, which require what is included to be specified, and negative specified, which only require that what is excluded from the RECs be specified, thereby assuming all other attributes are included.

<sup>64</sup> RECS International is an NGO working to establish a European-wide voluntary market for renewable energy certificates. <http://www.recs.org/>.

<sup>65</sup> Article 5 of the European Directive 2001/77/EC of 27.09.2001.

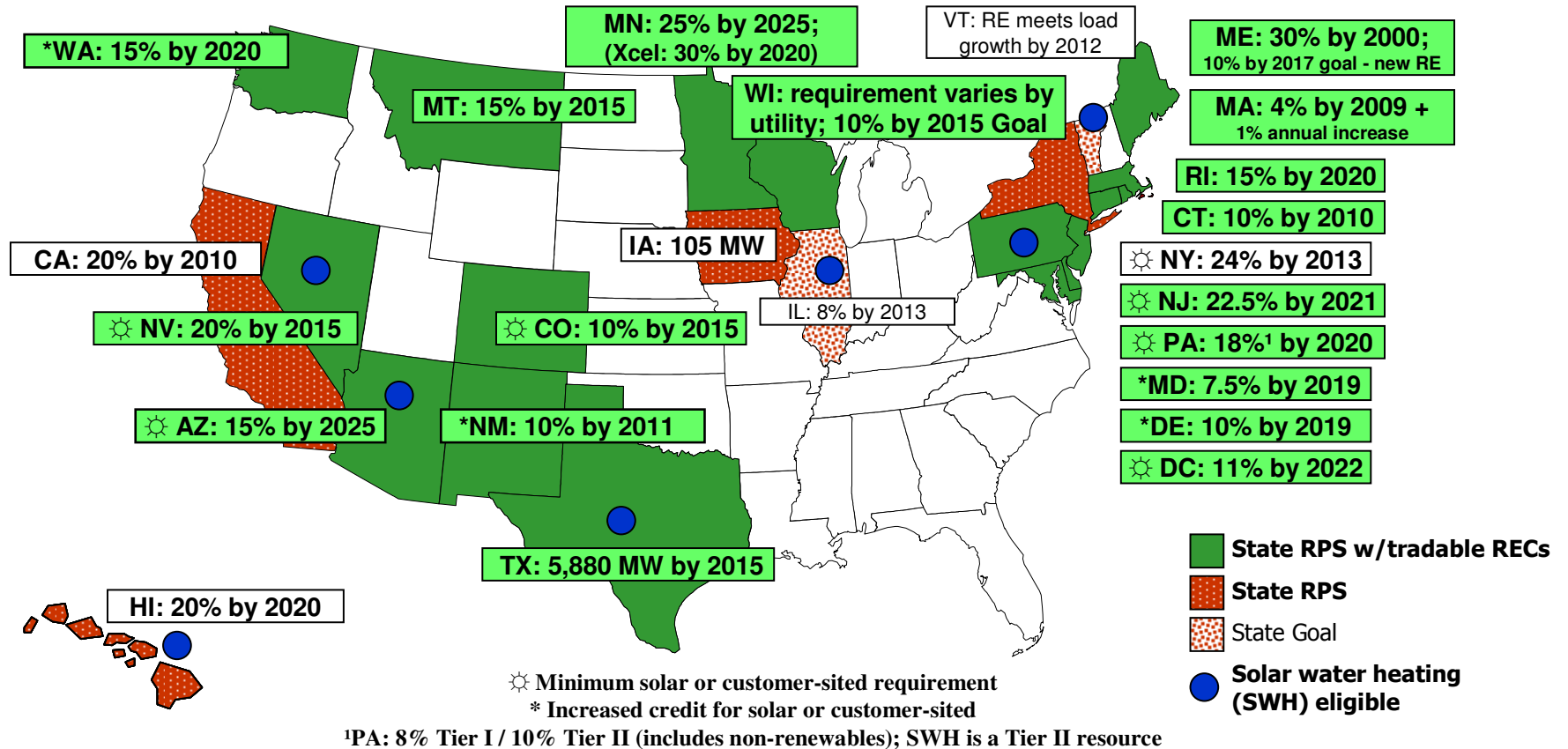
European Energy Certification System <sup>66</sup>	“[A EECS Certificate is a] unique Certificate specifying and representing the quality and method of production of a specific quantity of energy output, which is maintained on a EECS Registration Database, and Issued in accordance with the provisions of a Domain Scheme;
EUGENE <sup>67</sup>	Defines REC eligibility using project initiation date (entered operation after national market was liberalized) and regulatory additionality tests. Suggests that green power suppliers “be creative” in how they address additionality.
<b><i>Miscellaneous advocates, marketers and brokers in voluntary REC market</i></b>	
Clean Power Markets, Inc.	“...represents the positive environmental attributes associated with the MWh...delivered to the grid.” “...represents the environmental attributes of the renewable generator.” RECs “are the <i>non-physical products</i> , representing the air, water, land, and other benefits or avoided impacts associated with renewable energy production.” [emphasis added]
Chicago Climate Exchange	Requires that RECs be bundled with and/or retired if GHG offset to be sold from renewable project.
(Wingate and Holt, 2004)	RECs “represent the separate bundle of non-energy attributes (environmental, economic and social) associated with the generation of renewable electricity.”
(Pepper and Swanson, 2004)	“[A] PV system owner who sells RECs cannot also claim that they are ‘green-powered,’ ‘solar-powered,’ or ‘renewable-powered’, just that they are hosting a PV system.”
(Pepper and Swanson, 2002).	RECs are “non-physical products, representing the air, water, land, and other benefits or avoided impacts associated with renewable energy production.”
(Pino, 2006)	A REC represents the “technology and environmental attributes” or renewable generation. Companies that purchase and retire RECs should not claim to be “powered” by renewable power, but they can claim that they are “matching” their electricity consumption with RECs or buying RECs “equivalent” to their electricity consumption, or that they are “greening up” their electricity.

<sup>66</sup> Basic Commitment being The Principles and Rules of Operation of Members of the Association of Issuing Bodies for the European Energy Certification System, Version Release 3, 2 June 2006. EECS Certificates are defined to be consistent with European Guarantees of Origin.

<sup>67</sup> /www.eugenestandard.org/mdb/publi/17\_factsheet%20add%20&%20el%20final.pdf/  
/www.eugenestandard.org/mdb/publi/3\_Eugenestandard.pdf/

### Appendix B – State RPS mandates in the United States allowing tradable RECs\*

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4 \* Map modified to include tradable REC policies. Information as of end of 2006.

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