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Renewable portfolio standard: an analysis of design and implementation issues

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Abstract

The Renewable Portfolio Standard (RPS) is a policy tool that requires a certain percentage of renewable energy to be included in the portfolio of electricity resources serving a state or a country. The main purpose of an RPS is to foster the development of renewable energy market, increase the energy security by reducing the dependence on the imported energy sources (oil, etc.), and, to provide environmental benefits from using more renewable energy. There are different approaches to the design and implementation of RPS in different states in U.S. and the degree of achieving a success of the policy differs also, depending on the design features.

In 2004 New York has enacted an RPS that starts in 2006 and requires provision of at least 25% of electric energy from renewable energy sources by the year 2013. This study analyzes the design and implementation approaches of RPS in Arizona, Hawaii, Maine, Texas, and Wisconsin in order to determine the key design features that lead to a successful implementation of the policy in order to develop recommendations for RPS in New York and in other states that may implement an RPS. In order to evaluate the degree of success in the case-states an RPS Metric System was designed. It evaluates the target setting of the policy, the achievements of the policy and the growth of renewable energy as a result of the RPS implementation.

As a result of the conducted study a set of recommendations was designed for consideration by New York state during the scheduled review of RPS implementation in 2009 as well as for other states during the design and implementation of the policy.

1. Introduction and the Purpose of the Study

Renewable energy in today's electricity markets needs to have support in order to develop further and become competitive with conventional energy. There are a number of policies aimed at providing renewable energy with opportunities for development. One of the most widely used is "Green Marketing", which offers the consumers a choice to voluntarily purchase electricity from renewable sources at a price premium. But experience shows that Green Marketing alone can not significantly foster development of renewable energy (Rader and Short III, 1998). From this perspective the Renewable Portfolio Standard (RPS) may represent a more effective policy option. The RPS was first introduced by the American Wind Energy Association in 1996 during the deregulation of the California electricity market (Wiser *et al.*, 1998). Later this policy was adopted in a number of states in the U.S, and also in some countries worldwide.

1.1. The concept of RPS and the purpose of this research

The purpose of an RPS is to ensure the creation of a sustainable, competitive renewable energy market by requiring retail electricity suppliers, electricity generators, and/or consumers to source a minimum percentage of their electricity from eligible renewable resources.

There are a number RPS design examples available, but they do not differ much from each other. The initial approach to RPS design is that of the American Wind Energy Association (AWEA). AWEA argues that the requirements of an RPS should apply equally to all retail electricity sellers. In addition the regulatory role in RPS should be limited to certifying credits, verifying that retail sellers possess the required number of credits at the

end of each year, and imposing a significant penalty for non-compliance on retail sellers that fall short.

One of the main propositions of an RPS is that the electricity market should make all decisions regarding which renewable plants to build, where, and for what price. The results should be the generation of a certain amount of renewable power by a certain date, and that market forces should ensure the lowest possible costs (AWEA, 1997).

It is necessary to consider the experience of other states in RPS design and implementation to learn the achievements and especially the problems that the other states experienced during that process. The purpose of this research is to analyze the experience of RPS design and implementation in other states in order to develop recommendations for other states that may implement the policy, and for the NY RPS case. These recommendations may be taken into consideration during the NY RPS review process in 2009.

1.2. RPS Approaches

According to the AWEA approach, an RPS must have the following essentials for the creation of a market for renewable energy (Rader, 2000):

- ✓ *A percentage obligation should be placed on all market participants serving a state or country.* All retail suppliers of electricity are required to demonstrate that they have supported the generation of an amount of electricity from qualifying renewable energy sources equal to a certain percentage of their total sales.

- ✓ *Noncompliance with the requirements is subject to a high automatic penalty.* The penalty, imposed on non-complying retailers should significantly exceed the cost of compliance.
- ✓ *The obligation should be long-term.* This may be achieved in one of the three ways: by making the policy indefinite; by ending the policy at least 10 years after the last increase in the percentage requirement takes effect; or through a "self-sunset', when the market of renewable energy stabilizes, and there is no further need for an RPS.
- ✓ *The required amount of renewable energy should grow over time*. This can be accomplished in one of the three ways:
    1. *Single percentage requirement.* The required amount begins at the level of existing renewable sources used for electricity generation (those types requiring support to remain in operation) and grows over time.
    2. *Exclude all existing renewable sources from eligibility.* This method is appropriate if existing renewable sources do not require support to remain in operation, if those renewable sources are obtaining other means of support, or are deemed to be worthy of public support.
    3. *Establish separate "tiers"*. One tier is set equal to the existing amount of eligible renewable sources (those requiring support to remain in operation) and is open to competition from existing and new projects. A second tier is open to new projects or to a narrower group of new projects.
- ✓ *The definition of renewable sources should exclude hydropower and non-renewable sources.* AWEA argues that the hydropower can not be considered as a renewable

energy source as it has potentially negative effect on natural resources, particularly for fish..

- ✓ *A system of tradable renewable energy credits (REC) should be created in order to make the compliance with the requirements more flexible. Renewable energy credits* – a tradable certificate of proof that one kWh of electricity has been generated by a renewable-fueled source and sold to the retail supplier in the state.

Besides the environmental benefits, one of the main purposes of an RPS is to create market conditions that will ensure low-cost renewable energy generation. There are two ways in which the RPS should assure least-cost achievement of a state's renewable energy goals, including:

1. Long-term contracts and financing for the renewable power industry

2. Provision of flexibility to retail sellers, who can compare the cost of owning a renewable energy facility to the cost of a REC.

These should foster development of a sustainable market for renewable energy and make it more competitive with the conventional energy.

2. Literature review

RPS is a concept of quota obligation that is being imposed on the participants of the electricity market in order to ensure that the electricity portfolio contains a certain amount of power generated from renewable energy sources. The main purposes of an RPS is to achieve environmental benefits and promote renewable energy into the electricity market without significant increase of the electricity prices.

The popularity of RPS is increasing due to three main reasons (Berry, 2001):

- ✓ RPS provides incentives for renewable energy generators to decrease the cost of energy as a result of cost competition among producers for their share in the RPS;
- ✓ RPS target is being established by the government, thus it ensures that the implementation of the policy will lead to specific environmental and economic benefits;
- ✓ In the same time the RPS minimizes government involvement into the process, as the main forces that affect the implementation of the policy after it being adopted are the market forces.

2.1 RPS design

The initial RPS design was first proposed by AWEA during the California Public Utilities Commission's electricity restructuring procedure in 1996 (Wiser *et al.*, 1998). Since then there have been a number of states that adopted the RPS as part of their electricity restructuring process.

The design of RPS in all states that have implemented this policy does not differ significantly from its initial design by AWEA. A good RPS design consideration was presented by Berry and Jaccard (2001). According to them the essential parts of an RPS design are:

1. *RPS target – a certain quota obligation put on all of the electricity serving utilities in the state. It requires the electricity serving utilities to generate a certain amount of their electric energy from renewable sources.* In establishing the target it is necessary to take into the following issues:

– Size of the target should be large enough to foster the development of the renewable energy market, but taking into consideration the possible risk of increase of electricity price;

– Timing of RPS should be selected in a way to provide enough time for development of new generation facilities if the existing facilities are not eligible or sufficient to meet the required target; and to secure low-cost project financing with long-term supply contracts;

– Choice of renewable sources to be included in an RPS is important. One renewable energy type may capture the entire RPS market, thus prohibiting the development of other types of renewable sources that could become competitive, given the opportunity for commercial development.

– Provision of a cost cap for electricity may be required in order to counter the risk of increase of electricity prices as a result of market reaction to the achievement of RPS target.

2. *Eligible resources.* A list of eligible renewable resources should be developed for the RPS depending on the objectives and the capabilities of local energy markets. Regulators should decide whether to include existing renewable resources in the list or it should only contain the new resources; whether the RPS should include only grid-connected and/or off-grid resources; whether a consideration should be given to facility size; and, whether imported energy should count towards RPS.

3. *Applicability of RPS.* Policy makers decide the geographic coverage of the RPS; its application to the specific market participants; and, whether other policies, such as green marketing should be credited for RPS target or not.

4. *Flexibility mechanisms.* Policy makers should consider some flexibility mechanism for achievement of the RPS target. Those mechanisms include:

– Account balancing mechanisms for producers, which takes into consideration the possibility of providing extra time to producers in case they do not meet the target, particularly important for producers who use a renewable source that have generation uncertainties, such as wind, or solar energy that may vary depending on specific weather conditions.

– Trading mechanisms for producers, which allow the generators having an access of energy to sell it to those with shortage of it. This mechanism may include the tradable renewable energy credits (RECs), representing one megawatt per hour of renewable energy that is physically metered and verified in the State according to the eligibility requirements of RPS.

5. *Administrative issues.* These may include the certification of renewable resources, monitoring of the compliance, and setting penalties for non-compliance with the requirements by an administrator of the RPS.

REC Trading

The requirement of an RPS for purchase or generation of a certain percentage of renewable energy may not always be economically and practically achievable. The widely used REC mechanism provides some flexibility for energy providers to comply with RPS obligations. By purchasing the necessary RECs the retail electricity providers are complying with the mandated requirement.

The problem with the REC market is that it is does not quickly adjust to the changes in the electricity market (Chupka, 2003). On one hand it is very difficult to control the demand for overall electric energy, which determines the demand for REC. And on the other hand it is difficult to adjust the amount of renewable energy generation as a part of an RPS, which determines the supply of RECs, to the changing demand for overall energy. Despite fixed RPS requirements for a certain percentage of renewable electric energy, it is not possible to predict the potential demand and supply of RECs in a current year. The annual amount of RECs depends on the actual annual electricity sales and renewable energy generation. This is explained by the fact that the demand for electricity is a function of economic conditions and the weather, and there is not much a retail electricity provider can do to alter its demand for RECs. On the other hand the renewable energy generation facilities often require years for design and construction (besides small scale wind turbines and solar photovoltaic (PV) cells), and after being built their generation capacity almost always stays the same – depending

mostly on the weather conditions. The high demand for RECs cannot increase the amount of generated renewable energy immediately as it depends mostly on weather conditions. But at the same time, the high demand for RECs may foster development of new renewable energy generation facilities by making the investments more attractive. Conversely, low demand and prices for RECs will not reduce the renewable energy generation capacity.

As a result of relatively inelastic demand and supply for RECs in the short term, together with uncertainties regarding the overall electricity demands and the amount of renewable energy generation, unstable prices for RECs may result (Chupka, 2003). The price instability may negatively affect the investment market for new renewable generation facilities as a result of increased financial risks.

It is also very important, prior to enactment of the RPS policy, to forecast electricity generation costs and prices in order to evaluate the feasibility of the proposed renewable energy target (Fan *et al.*, 2003). This will help the policy makers to establish an RPS target and list of eligible sources that may prevent high volatility in the RECs' prices during the period of the policy enactment.

In order to avoid the price volatility risks, the REC sellers and buyers should get into long-term bilateral contracts. This will help the renewable energy generators attract more investors, providing payback guaranties from selling the energy for a long time. The retail sellers of electricity may prefer to get into long-term contracts in order to avoid the possible price changes in the REC spot market. The early experience of the Texas RPS showed that most of the trades of RECs were long-term bilateral agreements (Langniss, Wiser, 2003).

Although long-term contracts protect the retail providers from possible RECs price increase; they also limit flexibility in purchasing possibly more economically attractive RECs

(Roschelle, Steinhurst, 2004). Short-term one-year contracting would allow the retail electricity providers to deal with the uncertainty of the overall amount of renewable energy needed to meet a certain percentage requirement of an RPS. In addition, shorter term contracting would allow retail providers flexibility to participate in new, more economically attractive REC markets.

In sum, it is necessary for retail electricity providers to have a certain percentage of their renewable energy portfolio from long-term contract obligations, and the other part from short-term contracts, in order to both protect them from possible price increase of RECs, and also to give them some flexibility to adjust to the current spot market trends.

Penalties and cost caps

Another means to regulate price volatility of RECs includes the use of penalties and cost caps (Chupka, 2003).

Penalties are imposed on the retail sellers if they do not meet the RPS requirements. The penalties should be set high enough to ensure compliance with the requirements. It should be cheaper to comply with the RPS obligations than to pay the penalties for non-compliance (Espey, 2001).

The Texas REC market has a penalty system where it is computed as a lesser of $50/MWh or twice the average REC price during the compliance period (Langniss, Wiser, 2003).

Cost caps are set to secure the retail providers of energy from the price increases. The cost cap is the price at which retail providers can buy the RECs in order to limit the overall

cost of RPS policy from the administrative authority, in case of a regulated electricity market, or from an independent renewable energy generator in a free market (Chupka, 2003).

Besides the price caps it may also be necessary to set price floors, in case the generation of renewable energy encouraged by the RPS is more than needed to comply with the requirements – as a result of low overall demand for electricity. The price floors could be set by government, fixing the lowest price for a REC and thus protecting the renewable energy generators from. On the other hand the government could also buy RECs through a fund and remove them from the market thus stabilizing the prices (Espey, 2001).

Another alternative to the penalties and cost caps could be to reduce the RPS requirement in case experience shows that retail suppliers cannot comply with the requirement without increasing energy costs (Rader, Norgaard, 1996).

As another means of reducing the price volatility of RECs the policy could provide banking option. The concept of banking is that the excess of RECs generated in one period can be used towards compliance during the next period (Chupka, 2003).

2.2 The current state or RPS in United States

There are seventeen states in the U.S. that have implemented some form of an RPS. The States, year of enactment, target requirements and eligible renewable sources are presented in Table 2.1.

Table 2.1. The current state of RPS in United States

State	Year enacted	Requirement	Eligible sources
Arizona	1999	0.2-1.1% of sales from 2001-2007	60% solar photovoltaic (PV) and 40% solar hot water, in-state landfill gas, wind, and biomass
California	2002	Annual increase of 1% of sales, reaching 20% by the year 2017	Solar PV, solar thermal, wind, biomass, landfill gas, digester gas, geothermal, and ocean energy
Connecticut	2003	6.5-10% of generation by the year 2010	Class I: solar, wind, sustainable biomass, landfill gas, run of river hydro (<5 MW), fuel cells, low-e RE conversion tech; Class II: hydro, municipal solid waste, other biomass
Hawaii	2001	Gradual increase of 7% in 2003, 8% in 2005, 10% in 2010, 15% in 2015, and 20% in 2020	Wind, solar, hydro, landfill gas, municipal solid waste, geothermal, ocean, biomass, hydrogen fuels, and fuel cells
Illinois	2001	5% of electricity sales to be generated from renewable sources by the year 2010, and 15% by 2020	Wind, solar thermal energy, PV, energy crops, organic waste biomass, and existing run-of-river hydro power
Maine	1999	30% of sales to be from renewable sources by the year 1999	Fuel cells, tidal power, solar, wind, geothermal, hydro, biomass, and municipal solid waste under 100 MW

Maryland	2004	Tier 1 or 2 sources to provide 2.5% during 2006-2018 and thereafter, and Tier 1 sources to provide 1% in 2006, increasing to by 1% biannually to 7% in 2018, 7.5% in 2019, and thereafter	Tier 1: solar, wind, biomass, ocean, fuel cells (renewable sources only), and small hydro power (<30 MW); Tier 2: hydro, municipal solid waste and incineration of poultry litter
Massachusetts	1997	1-4% of energy sales to be generated from new renewable sources during the years 2003-2009 and thereafter until date determined by the Division of Energy Resources	Solar, wind, ocean thermal, wave, tidal, landfill gas, low emission advanced biomass, and existing hydro and municipal solid waste
Minnesota		First requirement: 425 MW of wind power and 125 MW of biomass by 2002, 400 MW more wind power by 2006. Second requirement: 10% above the existing requirements by 2015, and also requiring that at least 0.5% of the total must be generated from biomass in 2005, increasing to 1% in 2010	Under the first requirement (until 2006): wind and biomass, with preference for in-state projects. Under the second requirement (10% by 2010): solar, wind, small hydro (<60 MW), biomass, municipal solid waste, landfill gas, and hydrogen after 2010 (from renewable sources only)

Nevada	2001	5-15% of energy sales to be from renewable sources during 2003-2013 and minimum 5% of total renewable energy sold each year to be generated from solar sources	Wind, solar, hydro power (<30 MW), geothermal, biomass (including wood, municipal solid waste, aquatic plants, agricultural sources), and energy recovery facilities with no more power than 15 MW
New Jersey	2003	Class I or II technologies to provide 2.5% by 2004-2008, and Class I technologies to provide: 0.74% in 2004; 0.983% in 2005; 1.964% in 2006; 2.924% in 2007; and 3.84% in 2008. The policy also requires solar electric power to provide: 0.01% in 2004; 0.017% in 2005; 0.036% in 2006; 0.076% in 2007; and 0.16% in 2008	Class I includes solar, wind, fuel cells, geothermal, wave, tidal energy, landfill gas, sustainable biomass; Class II includes municipal solid waste or hydro (<30 MW) that meets high environmental standards
New Mexico	2002	5% of the sales in 2006 to be from renewable sources, increasing 1% per year to 10% in 2011	Wind, solar, geothermal, biomass, hydro power (<5 MW), landfill gas, and fuel cells
Pennsylvania	1998	Implementation of a number of individual agreements with utilities to ensure provision of certain amounts of energy from renewable sources to customers	Solar, wind, sustainable biomass, ocean and geothermal energy

Rhode Island	2004	3% of renewable energy by 2007, increasing 0.5% per year to 4.5% in 2010, then increasing by 1% to 8.5% in 2014, then increasing 1.5% per year to 16% in 2019	Solar, wind, ocean, geothermal, biomass, co-firing, hydro power (<30 MW), fuel cells using renewable resources only
Texas	Enacted in 1999, and started in 2002	1280 MW by 2003, 1730 MW by 2005, 2280 MW by 2007, and 2880 MW by 2009 until 2019	Solar, wind, geothermal, hydro power, wave energy, tidal, biomass, biomass-based waste products, and landfill gas
Wisconsin	2000	0.5% by 2001, increasing to 2.2% by 2011	Wind, solar, biomass, geothermal, tidal energy, hydro power (<60 MW), and fuel cells using renewable resources
Notes: The data for this table were acquired from the following sources: EIA (2003) and Union of Concerned Scientists (UCS) (2004);			

3.3 Studies of RPS

There have been a number of studies evaluating RPS design and implementation. These studies help inform future RPS decisions.

A study by Rader (2000) evaluated RPS failures defined as deviations of the RPS design from the design offered by AWEA. In her article, Rader argues that in order to successfully implement an RPS one must follow a design that requires:

- ✓ Equal obligations should be placed on all participants (retail sellers) of the electricity market;

- ✓ Large-scale hydro power should be excluded from the list of eligible sources;
- ✓ Penalties should be imposed for non-compliance with the requirements;
- ✓ The RPS should be long-term, to provide confidence for the investors that they will recover their costs during a reasonable period of time;
- ✓ The demand for renewable energy provided by the RPS should exceed the existing supply in order to ensure further development of the market;
- ✓ A system of tradable credits for renewable energy should be put in place in order to provide flexibility and ensure effective low-cost compliance with the requirements;
- ✓ There should not be any restrictions on the location of the renewable energy resources, in order to avoid a state protectionism against imported energy.

Rader presents the RPS in Texas as one that has all the essential attributes of successful RPS implementation. By 2001 Texas had exceeded required RPS targets for 2003 (1280 MW), having installed 915 MW of wind energy generation facilities in that year alone (Langniss *et al.*, 2003). However, when considering Texas as an example of successful rpa design and implementation we should consider the initial state of renewable energy generation and capacity in the state. The initial amount of energy generated from renewable sources in Texas was 880 MW in 1999 (EIA, 2004). With this respect, the requirement of achieving the 1280 MW target in 2003 was a very modest goal. In addition, according to the Department of Energy Texas had an estimated wind power potential which exceeded the electricity consumption in the state by over 400% in 2000 (Langniss *et al.*, 2003). There was also a Federal Production Tax Credit that provided 1.7 (US) cent/kWh credit for wind energy, thus reducing the price and making it the most competitive type of renewable energy in the market.

Despite this, overall, the Texas RPS represents a successful example of design and implementation of this policy, if the main criterion of success is that the renewable energy targets were achieved in time.

3.4 Conclusion

The following conclusion can be made from the conducted literature review. Policy makers should give serious consideration of the design of an RPS based on the past experience of other states, in order to ensure implementation of the policy.

The studies of the RPS were conducted by comparing the design with actual implementation in order to evaluate either a success or a failure of the policy. The main criteria for evaluation of the RPS were achievement of the required target and growth or renewable energy in the state.

3. Methodology

3.1 Overview

This research was implemented using a multiple-case study approach. This method of research used the analysis of RPS implementation in a number of case-states. Cross-case implications were identified and used for development of recommendations on design and implementation of an RPS.

According to Yin (1994) the multiple-case study method should consist of the following components:

- *Study questions* – a set of questions designed to acquire necessary information;
- *Study propositions* – propositions that direct attention to something that should be examined within the scope of the study;
- *Units of analysis* – related to definition of the "cases";
- *Linking data to propositions* – "pattern matching", in which several pieces of information from the case should be related to some theoretical proposition ;
- *Criteria for interpreting the findings* – for example, one data may match the pattern more than the other, etc.

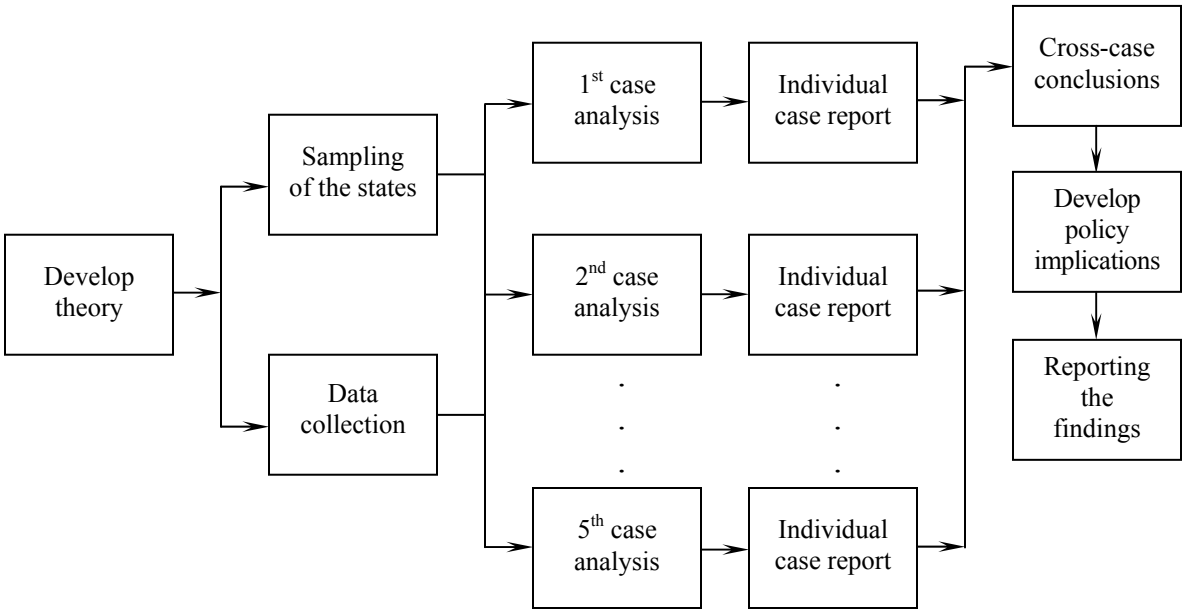
Following Yin's approach, this research was conducted based on the following components:

- *Study questions*. These questions were prepared and used during interviews with representatives of the case-state agencies in charge of implementation of the RPS. The questions and results of the interviews are presented in Appendix A.
- *Study propositions*. These are the propositions that focused the research on specific issues – e.g. that the design of the RPS should be done in a certain way in order to achieve successful implementation.
- *Units of analysis*. The units of analysis in this research are the RPS data in the chosen state-cases. Those units include the initial percentage or KWh requirement of the RPS, the annual data on energy portfolio in that state, etc.

– *Linking data to propositions*. This stage involved comparison of the actual data – achievements of the RPS with the design values. This technique is called "pattern matching" (Yin, 1994), in which the pieces of information from the cases should be related to theory - in this case design propositions.
– *Criteria for interpreting the findings*. The main criteria for interpretation of the findings were the results of pattern-matching of the actual data from the states with the designed values of the RPS in those states.

The graphical replication of the multiple-case study approach in this research is illustrated in Figure 1.

Figure 3.1. Multiple-case study approach



The detailed explanation of each step is as follows:

1. Develop theory. In this stage the basic theory of the research was developed. The main theory of this research was: "The states that were stricter, i.e. those that included a set of penalties in the RPS design and had a regulated REC market were more successful in implementation of the RPS policy." Later in this research the theory was tested through evaluation of the RPS implementation in the chosen case-states.

2. Sampling of the states. In this stage all the states that implemented RPS in the U.S. were analyzed, and five of those states were chosen, based mainly on the duration of the RPS, as the existence of implementation data was very important in evaluating the success or failure of the policy.

3. Data collection. This step included collection of documentation on RPS design and implementation, data on electricity generation and use in the case-states, interviews with the representatives of the agencies that are in charge of implementation of the RPS in those states. The survey asked the participants to identify the following aspects of the RPS in the case-states:

- ✓ What were the driving forces behind the policy?
- ✓ What were the goals of the RPS besides the energy security and environmental goals?
- ✓ Whether there was a public support for the policy or not?
- ✓ Whether there was a support of Electric Utilities for the policy?
- ✓ Whether there was a support of Renewable Energy Representatives for the policy?

The survey also asked the participants to identify the criteria for measuring a success of RPS in their states and also to define whether there was a success or not.

4. Cases analysis. During this step the information that was collected was analyzed. For the analysis of RPS design and implementation in the cases-states an RPS Metric System was designed. The idea of this system is to evaluate the following criteria:

- ✓ Target Setting (TS). This criterion shows the required percentage increase in the renewable energy between the RPS requirement of the first year and the

renewable energy share in electricity portfolio of the state the year before the enactment of RPS. It is calculated according to the following equation:

$$TS = \frac{RPS_{1^{st}\,year} - RE_{E-1}}{RE_{E-1}} \times 100\% \qquad (3.1)$$

where,

$RPS_{1^{st}\,year}$ is the requirement for the fist year of the policy;

RE_{E-1} is the amount of renewable energy in the electricity portfolio of the state the year before the enactment of RPS.

The Target Setting allows to evaluate the "reasonableness" of the RPS. As the idea of any RPS is to facilitate further development of the renewable energy in the state, the higher the target setting, the more aggressive the policy is, thus requiring more growth of renewable energy share in the total electricity portfolio of the state. However, it is necessary to mention that this criterion does not take into account the feasibility of the RPS requirements.

- ✓ RPS Achievements (A). This criterion shows what percentage of the RPS requirement for the year 2003 was achieved. The most recent data for the cases states are available for the year 2003, which was the main reason of choosing it as the benchmark year for this evaluation. RPS Achievements criterion is calculated according to the equation (3.2):

$$A = \frac{RE_{'03} - RPS_{'03}}{RPS_{'03}} \times 100\% \qquad (3.2)$$

where, $RE_{'03}$ is the share of renewable energy in the electricity portfolio of the state in 2003; $RPS_{'03}$ is the RPS requirement for 2003.

- ✓ Renewable Energy Growth (G). This criterion measures the change of renewable energy share in the total electricity portfolio during the period of RPS enactment year through 2003. It allows to evaluate whether the RPS affected the growth of renewable energy in the electricity portfolio of the state or not. This criterion is calculated according to the following equation:

$$G = \frac{RE_{'03} - RE_{E-1}}{RE_{E-1}} \times 100\% \qquad (3.3)$$

The 1st, most important criterion in the proposed metric is the Target Setting, because this is the main driving force of the policy. Without an appropriate Target Setting that would foster the development of renewable energy in the state, the policy may lack its strength.

The 2nd, most important criterion for measuring the success of the policy is the Renewable Energy Growth. The growth of renewable energy is the most important purpose of any RPS. There are cases when the Target Setting is initially set very low, thus ensuring a high RPS Achievement, which does not necessarily ensure a growth of renewable energy at all. In order to account for such an overlook/omission, the Renewable Energy Growth is assigned more "weight" than the RPS Achievement in the proposed metric.

The 3rd criterion according to its importance is the RPS Achievement.

The classification of the degrees of RPS success based on the three criteria is presented in Table 3.1. The (+) means that the criterion is >0, and (-) means that the criterion is <0.

Table 3.1 Degree of RPS Success

Target Setting	RPS Achievement	RE Growth	Degree of RPS Success
+	+	+	HIGH
+	-	+	HIGH MEDIUM
+	+	-	MEDIUM
+	-	-	LOW MEDIUM
-	+	+	LOW MEDIUM
-	-	+	LOW MEDIUM
-	+	-	LOW MEDIUM
-	-	-	LOW

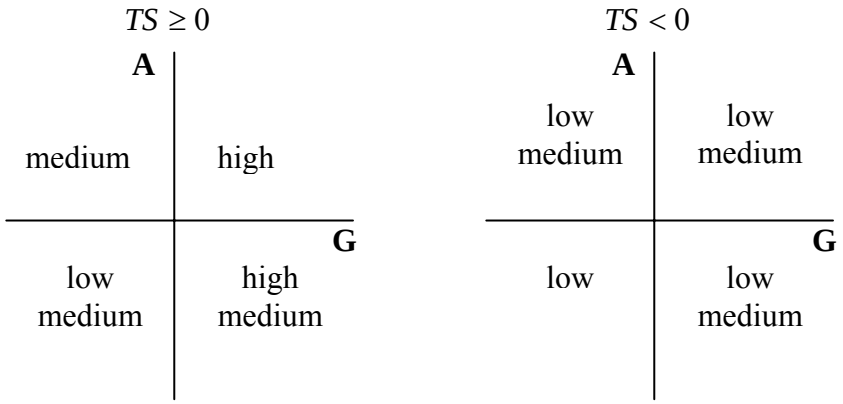
As it is evident from the Table 3.1, the case when all three criteria are positive is the most successful case of RPS implementation. The case when all three criteria are low, is the least successful case. The case when there is a positive Target Setting, a negative RPS Achievement, and a positive Growth in renewable energy is considered a High Medium success, as the growth of renewable energy is a very important criterion, even if the goal of the policy was not achieved. The case when there is a positive Target Setting, a positive RPS Achievement, but a negative Growth of renewable energy is considered a Medium success of the policy, because although the goals of RPS are achieved, nevertheless there is not any growth of renewable energy, which is the most important purpose of the policy. The case when there is a positive Target setting, but negative RPS Achievement and Growth is considered a Low success because although the TS is positive the policy did not achieve neither its

goals, nor any growth of renewable energy. The cases when the Target Setting is negative, and either or both the RPS Achievement and the Growth are positive are considered a Low success because if the TS is negative, it means that the policy does not require any growth of the renewable energy, thus the success of the policy is limited from the beginning.

After calculating the three criteria, the $A = f(G)$ function was built and analyzed for each state when TS≥0 and TS<0 in order to determine the degree of RPS success.

Figure 3.2 represents the two-dimensional surface for the aforementioned function, and the classification of the RPS success for each function, based on the quarters where the certain case-state is located. By plotting all the case-states within this graphical framework, we can more easily see what states may have achieved higher success than others allowing us to evaluate tradeoffs between states more effectively.

Figure 3.2 Classification of RPS success based on the Target Setting



There are a number of limitation of the designed RPS Metric System:

1. The Metric System does not take into account the duration of the RPS implementation period. When the Renewable Energy Growth is measured, it does

not account for the length of the policy implementation. It only measures the difference between the renewable energy share before the policy implementation and the current share of it in the electricity portfolio of the state.

2. The Metric System does not account for the import of renewable energy which may constitute to the overall RPS goal of the state. Thus, when measuring the Renewable Energy Growth, this criterion may reflect the import of eligible renewable energy also, which does not allow to evaluate the in-state renewable energy growth.

3. The Metric System does not account for the REC trading, whereas this mechanism plays a very important role in implementation of the RPS policy.

5. Cross-case conclusions. During this step a matrix was developed that put the individual case reports together and gave an opportunity to compare those and to determine the differences between the cases both during the design and implementation of the RPS.

6. Develop policy implications. Based on the cross-case matrix of a set of policy implications on the design and implementation stages of RPS was developed.

7. Reporting the findings. This step included preparation of the final report on the findings of the research and the recommendations on RPS design and implementation in other states, and particularly in NY State. This step also included presentation of the results to the thesis committee members, and also to the representatives of NYSERDA and other agencies that are involved in the design and implementation of RPS in NY State.

Using the case study approach in this research was justified by the fact that the analysis of RPS application in the other states will allow to identify its barriers and achievements in order to come up with policy recommendations on RPS application in other states.

3.2. Application of the research method to RPS in other states

The purpose of this study is to develop recommendations for successful design and implementation of RPS in other states and NY State in particular based on the experience of case-states. According to NYSERDA (2003), the successful implementation of RPS in NY will improve the energy security, reduce the air emissions as a result of energy generation, diversify the New York's electricity generation market, provide economic incentives for development of renewable resources, and attract renewable resource manufacturers and installers.

As a result of conducted analysis of RPS design and implementation the case-states, as well as evaluation of success of the policy according to the RPS Metric System, a set of recommendations was developed for consideration during the design and implementation of an RPS in other states.

3.3. Sampling procedure

The sampling procedure for selection of the case states is a non-probability sampling, which was based on the duration of the RPS in those states. The duration was the key criterion for selection of the case-states because it determined the availability of the sufficient

data necessary for conducting this research. Five states were selected based on the length of time their RPS was in place.

The sampling procedure included the following steps:

- ✓ Definition of the sampling population – the states that have implemented the RPS;
- ✓ Acquiring information on the process of RPS design and implementation;
- ✓ Selection of the five case-states.

3.4. Data Collection

The following sources were used in this research (Tellis 1997):

– *Documentation*. This included study reports on the application of RPS in other states and other relevant documents such as the legislative documents, etc. Information was also acquired by contacting the agencies that are in charge of implementation of the RPS in the chosen states. The validity of the documents was reviewed to avoid incorrect data being included in the database, (especially those from the Internet) by contacting the authors of the documents.

– *Archival record.* This included service records and organizational records on the electricity generation and sale in the case-states, obtained from the utilities and federal or state agencies.

– *Focused Interviews*. The interviews were conducted via e-mail. During those interviews the representatives from the state agencies that are implementing the RPS in the case-states were asked specific questions, designed in advance based on the study implications. The representatives of the state agencies were chosen for interviews based

on their level of involvement in the RPS implementation procedure. The questions asked to the representatives of those agencies included:

1. How would you characterize the development of RPS in your state? Was it more a politically driven decision or it was driven by the environmental and energy security issues mostly? Please, explain.
2. Was there public support for renewable energy? How was the public support evaluated?
3. Were there any policy goals of the state besides energy security and environmental? Please, explain.
4. What was the reaction of utility companies to the RPS obligations?
5. What was the reaction of renewable energy generators?
6. Do you think that the RPS in your state achieved success? What are the criteria of measuring success of RPS in your state? Please, explain.

There were some barriers for collecting the data on the RPS implementation in case-states that was due to insufficient archival records and the level of willingness for cooperation of the corresponding organizations and individuals.

3.5. Data Analysis

The general strategy of data analysis is "pattern-matching" (Yin 1994).Here the purpose of this technique is to compare the designed and real outcomes of RPS implementation in chosen states to identify barriers in meeting RPS requirements.

The analysis of the acquired data was conducted in the following steps:

1. Designing a set of criteria for measurement of successful implementation of RPS. The criteria included (Rader, Hempling, 2001):
    a. Required percentage of renewable energy at the end of RPS.
    b. Designed and real growth of renewable energy percentage per year.
    c. Development of new clean renewable energy generation sources in state.
    d. Development of sustainable renewable energy market. This included the analysis of the REC market.
    e. Minimal cost for the environment.
2. Evaluation of each criterion for each state and designing a matrix that included all the criteria for each state.
3. Comparison of the criteria between case-states in order to determine the general and specific barriers that the RPS implementation encountered in those states, as well as the achievements.

3.6. Limitations of the study

There may be a number of limitations for this study, but the main limitation is the short period of RPS implementation in the case-states, and as a result – lack of the information and insufficient data on the process of implementation of RPS.

A similar case study approach was used by Rader (2000). In her article Rader analyzed the experience of RPS implementation in seven states – Connecticut, Maine, Massachusetts, Nevada, New Jersey, Texas, and Wisconsin, based on some provisions of the RPS. The article analyzed the design issues of RPS in those states, and as a result of the conducted

analysis, Rader pointed that the failure of the RPS in those states was partly due to not following the initial RPS requirements.

This research differs from the analysis done by Rader by the specific goal of application of the experience of RPS in other states to the NY case, also taking into account the relevance of the experience of those states to the case of NY based on the similarity of the renewable energy potential, definition of renewable energy sources, and the structure of renewable energy market.

4. New York Renewable Portfolio Standard

Overview

The 2002 NY State Energy Plan required New York State Energy Research and Development Authority (NYSERDA) to examine the feasibility of establishing a statewide RPS for electricity generation, assess the economic impacts of an RPS, and determine whether and how an RPS might be harmonized with a restructured and competitive market and the goals from planned State actions to promote renewable energy development (NY State Energy Plan, 2002).

In response to the requirement of the 2002 State Energy Plan NYSERDA conducted an investigation showing that the RPS could be established in NY, and that it should provide:

1. Market certainty to renewable resource developers ensuring that there would be a retail market for power generated;
2. Confidence to the financial community that such projects would generate sufficient return on investments that compensate investors for financial risks; and
3. Assurance to customers interested in purchasing clean energy resources that there would be clean energy options available along with greater customer choice in service providers.

The purpose of the RPS in NY is to create a sustainable market for renewable energy, improve energy security, reduce the air emissions as a result of energy generation, diversify the New York's electricity generation market which will reduce the flow of money leaving the State to pay for imported electricity, complement the State's current Environmental

Disclosure Program, provide of economic incentives for development of renewable resources, and attraction of renewable resource manufacturers and installers.

Requirement

According to the order of the NY Public Service Commission (PSC) the RPS in NY will be centrally administered by NYSERDA, and it will have an incentive-based mechanism. The forecast of renewable energy share in the energy portfolio of the State is presented in the Table 4.1 (NY PSC, 2004).

Table 4.1 Incremental growth of renewable energy share[1]

Year	Target, MWh
2006	1,360,424
2007	2,821,830
2008	4,306,437
2009	5,787,968
2010	7,301,693
2011	8,867,181
2012	10,403,939
2013	11,988,888

The New York RPS requires that 24 % of the retail electricity sales in NY should be generated from renewable energy resources in 2013, and besides that it is anticipated that at least 1 % will be provided by voluntary market of renewable energy (NY PSC, 2004).

The process of RPS implementation will be reviewed in 2009 to assess the costs and benefits of the program, and make possible changes in the list of eligible renewable resources (NY PSC, 2004).

[1] The data in this table represent forecasting results and are subject to adjustments

Funding

The funding of the RPS will be done through a charge on customers' utility bills of each of the State's investor-owned utilities. According to PSC Order (2004) the cumulative impacts on residential electricity bills, for the life of the program, are forecasted to range from a reduction of 0.9 percent to an increase of 1.68 percent; for commercial customers, the range is a 0.78 percent reduction to a 1.79 percent increase; and for industrial consumers, the range is a 1.54 percent reduction to a 2.20 percent increase.

The funds collected through the utility bills will be administered by NYSERDA, and then will be awarded to eligible renewable energy generators through a bidding mechanism. According to the PSC Order (2004) further details of the central procurement system are to be worked out.

Eligible Renewable Sources

One of the most difficult issues of the NY RPS was the definition of eligible renewable energy sources. Renewable energy resources eligible for purchase under the NY Governor's Executive Order No. 111 are defined to include: wind, solar thermal, photovoltaic, sustainable managed biomass, tidal power, geothermal, methane waste, and fuel cells (GEO No 111, 2001). The *NY State Energy Plan* defines renewable energy as "... energy derived from resources that are not depletable or are naturally replenished when used at sustainable levels." (NY Energy Plan 2002) The State Energy Plan includes electricity generated from hydroelectric facilities as a renewable resource, whereas EO 111 does not include hydroelectric resources in the definition of resources that could be used to meet state agency renewable resource purchase requirements that are outlined in the Executive Order.

Additionally, in the Department of Environmental Conservation's Part 204 regulations renewable energy projects are defined as a power generation technology that produces electricity from wind energy, solar thermal energy, photovoltaic, methane waste, or sustainable managed biomass; but not the combustion or pyrolysis of solid waste (DEC 1999).

It is accepted that the criteria for definition of renewable sources should be founded on a requirement that the technology be relatively non-consumptive in the generation of energy. In this case hydropower should be considered as a renewable energy source because the "fuel" for hydropower is water which, in itself, is renewable, and is not consumed in the electricity generating process. Some experts point that hydropower is not a renewable resource because of its potentially serious effect on natural resources as it is for fish. They argue that only small hydropower facilities installed either on canals or pipelines, or installed in natural water courses in ways that only minimally disrupt the natural flow of a river, can qualify as a renewable source (Energy Policy 30, 2002).

The NY PSC Order 2004 requires establishment of two tiers of eligible resources. The first tier – "Main Tier" should consist of medium to large scale generation facilities that are expected to compete with each other on a price basis for their share in RPS. The second tier – "Customer-Sited Tier" should include the facilities that are not economically competitive with the first tier technologies. The list of eligible energy sources for RPS in New York are presented in Table 4.2.

Table 4.2 RPS eligible electric generation sources (NY PSC, 2004)

Main Tier	
Category	**Source**
Biogas	Landfill Gas (Methane) Reciprocating/Internal Combustion Engine
	Sewage Gas (Methane) Reciprocating/Internal Combustion Engine
	Manure Digestion (Methane) Reciprocating/Internal Combustion Engine
	Anaerobic Digestion (other biogas digestion using agricultural or food processing residues and by-products)
	Biomass Thermochemical Gasification (syngas)
	Biogas (from eligible sources of biomass feedstock) Combined Heat & Power (only the energy generated from the biomass portion is eligible)
Biomass	Biomass Direct Combustion
	Biomass Combined Heat & Power
	Biomass Co-fired with existing fossil-fuel Combustion (only the energy generated from the biomass portion is eligible)
Liquid Biofuel	Biomass Liquefaction through acid or enzymatic hydrolysis (Ethanol)
	Biomass Esterfication (Biodiesel, Methanol)
	Biomass Thermochemical Pyrolysis (Bio-oil)
	Biomass Hydrothermal Liquefaction
	Liquid Biofuel (from eligible sources of Biomass feedstock) Combined Heat & Power
	Liquid Biofuel (from eligible sources of biomass feedstock) Co-fired with existing fossil fuel Combustion (only the energy generated from the biomass portion is eligible)
Fuel Cells	Solid Oxide Fuel Cells (SOFC)
	Molten Carbonate Fuel Cells (MCFC)
	Proton Exchange Membrane Cells (PEM)
	Phosphoric Acid Fuel Cells (PAFC)

Hydroelectric	Hydroelectric Upgrades (no new storage impoundment)
	New Low-Impact Run-of- River Hydroelectric (<30 MW, with no new storage impoundment)
Solar	Photovoltaic
Tidal Ocean	Tidal Turbine
	Ocean Wave Turbine
	Ocean Current Wave Turbine
	Ocean Thermal Pumped Storage Hydro Powered by Tidal
Wind	Wind Turbines
Customer-Sited Tier	
Category	**Source**
Fuel Cells	Solid Oxide Fuel Cells (SOFC)
	Molten Carbonate Fuel Cells (MCFC)
	Proton Exchange Membrane Cells (PEM)
	Phosphoric Acid Fuel Cells (PAFC)
Solar	Photovoltaic
Wind	Wind Turbines (<300 kW)

As the objective of the RPS is to develop new renewable resources for New York's retail electricity market, the NY Public Service Commission requires that only new generation facilities developed after January 1, 2003 should be eligible for the RPS. The exception is given only to the following types of plants that are built before 2003:

(1) Wind power plants;

(2) Small hydropower plants, 10 MW or less (NY Public Service Commission, 2004).

REC Trading

Under the central procurement system of RPS, NYSERDA collects all funds from customers, and administers contracts to supply the required renewable generation. As all contracts are managed by NYSERDA, rather than individual compliance, the REC trading is not allowed. The RPS implementation review is scheduled for 2009, at which time the PSC may consider moving to a market-based system, including credit trading (REPP, 2004).

Green Marketing

According to the PSC Order (2004) the sales from green marketing program, which offers consumers to voluntarily purchase renewable energy, should not be counted toward the RPS target of achieving 24 % by year 2013, but its development will constitute to the achievement of additional 1 % of renewable energy in the year 2013, which will bring it to 25 % total.

Import

According to the PSC Order (2004) out-of-state import of electric energy generated from eligible renewable sources is allowed only if a calendar-month matching requirement between import and delivery is met.

Penalties

The RPS in New York does not provide penalties for non-compliance with the policy requirements. It is totally an incentive-based procurement, administered by NYSERDA (PSC, 2004).

Current Status

According to the PSC Order (2004) the RPS in New York is scheduled to start in 2006.

5. Arizona Environmental Portfolio Standard

Overview

In February 2001 the Arizona Corporation Commission (ACC) approved implementation of the Environmental Portfolio Standard (EPS).

The EPS was based on the Solar Portfolio Standard (SPS) that was adopted in 1996 as a part of the Retail Electric Competition Rule, which was designed to encourage the use of solar power as a source for electricity. The SPS required that 0.5% of the total portfolio of electricity to be generated from solar sources in 1999 and 1% in 2002 (Williamson, Wenger, 1998).

The policy was driven mostly by the environmental concerns and the idea of diversification of the energy sources used for electricity generation. Besides the environmental benefits of development of renewable energy , the purpose of the EPS was to achieve economical benefits by decreasing the reliance on the conventional fuels (Williamson, 2005).

According to ACC public support for the renewable energy was demonstrated through surveys, and written comments received by ACC. The renewable energy stakeholders, especially private industry supported the policy very much as before the EPS most of the renewable energy generation was developed by the utilities, not the private sector. On the other hand the electric utilities were strongly opposed the EPS (Williamson, 2005).

Requirement

The EPS required retail electricity utilities to provide 1.1% of the total electricity sales in the state to be generated from renewable energy resources by 2007.

According to the EPS requirements the portfolio percentage of renewable energy had to increase starting from the January 1, 2001 annually according to the Table 5.1 (ACC, 2001).

Table 5.1. Incremental growth of renewable energy according to EPS

Year	Portfolio Percentage
2001	0.2 %
2002	0.4 %
2003	0.6 %
2004	0.8 %
2005	1.0 %
2006	1.05 %
2007-2012	1.1 %

The EPS requirements are calculated on an annual basis, based on the electricity sold during the calendar year.

Besides the eligibility requirements, there were also a number of specific requirements (REPP, 2004):

a. In 2001, the renewable energy portfolio kWh makeup should be at least 50% solar electric and no more than 10% on research and development.
b. In 2002 and 2003, the renewable energy portfolio kWh makeup should be at least 50% solar electric and no more than 5% on research and development.
c. In 2004, through 2012, the renewable energy portfolio kWh makeup should be at least 60% solar electric.

ACC decided that the increase in the portfolio percentage would continue after December 31, 2004, only if the overall cost of the EPS would have declined. Otherwise, the retail renewable energy percentage would remain 0.8 percent from 2004 through 2012 (Renewable Energy Policy Project (REPP), 2003). The EPS legislation required submission of a progress review to the ACC in June 2003. The progress review was conducted by the environmental portfolio Cost Evaluation Working Group (CEWG) that was established by the Director of Utilities Division of Arizona Corporation Commission (R14-2-1618. Environmental Portfolio Standard).

Funding

The costs of meeting the EPS requirements for electricity providers is covered from the existing system benefit charges, and the new EPS Surcharge added to the customers' electricity bills, which was approved by the ACC in May 2000 (Renewable Energy Policy Project, 2003).

The EPS Surcharge is being collected and managed by the energy providing utilities (CEWG, 2003). It is based on each customer's monthly bill. The charges on monthly bills are the same for all customers - 0.000875 per kWh.

The maximum monthly surcharge is:

a. Residential Customers: $0.35 per service;
b. Non-residential Customers: $13.00 per service;
c. Non-Residential Customers whose metered demand is 3,000 kW or more for 3 consecutive months: $39.00 per service.

Eligible Renewable Sources

According to ACC (2001) the list of renewable resources eligible for EPS consisted of:

- ✓ Solar photovoltaic
- ✓ Solar thermal electric
- ✓ Solar water heating systems
- ✓ Solar air conditioning systems
- ✓ In-state landfill gas generators
- ✓ In-state wind generators
- ✓ In-state biomass generators
- ✓ Small hydro-electric generation
- ✓ Waste generation.

The photovoltaic and solar thermal resources located on the premises of the customers are counted as credits towards the EPS requirement of the Load-Serving Entity serving that customer.

REC Trading

In order to comply with the EPS requirements the electricity retailers have to either generate or purchase renewable energy, which should be certified as a renewable energy certificate (REC) representing one megawatt per hour of electric energy generated from eligible sources according to the EPS requirements. The trading of the renewable energy certificates is allowed between the Load Serving Entities that are subject to EPS, and there is not any specific provision for creation of those certificates (REPP, 2004).

Green Pricing

The electricity generated from eligible sources according to EPS requirements, and sold to customers under the Green Pricing programs are counted towards the electricity serving entity's compliance with the EPS requirements, upon approval of the Director of Utilities Division of ACC (REPP, 2004).

Import

The EPS legislation allows import of electricity generated out-of-state from only solar energy sources (REPP, 2004).

Penalties

The current EPS legislation does not provide any penalties for non-compliance with the requirements (ACC, 2001).

Criteria for EPS Success

According to the ACC (Williamson, 2005) the criteria for measuring the success of the EPS in Arizona are:

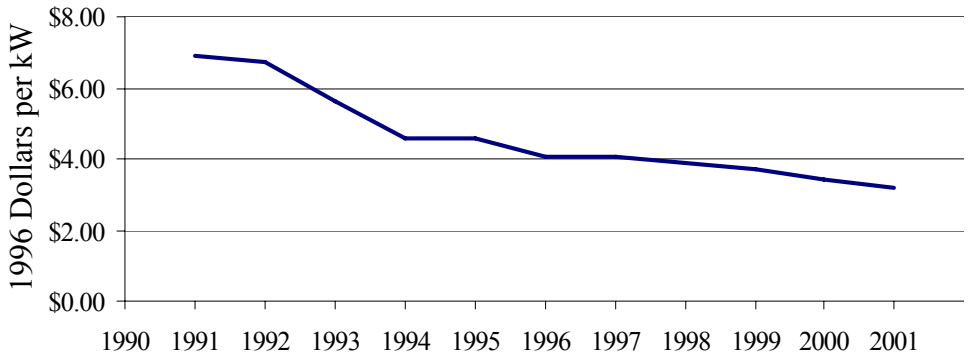
- ✓ Meeting the percentage requirements
- ✓ Cost-effectiveness of the generated renewable energy
- ✓ Growth and improvement of the private sector renewable energy companies and infrastructure in Arizona.

Current Status

According to the progress review submitted to the ACC by the CEWG, the prices for solar energy were declining during the years 1991-2001, which is presented in Table 5.2 (CEWG, 2003).

While the costs for solar energy generation systems decline – Figure 5.1, the solar energy industry is still developing, and it is difficult to do long-term cost projections, which decreases the rate of investments into the solar energy market (CEWG, 2003).

Figure 5.1. Photovoltaic Module Costs in Arizona 1991-2001



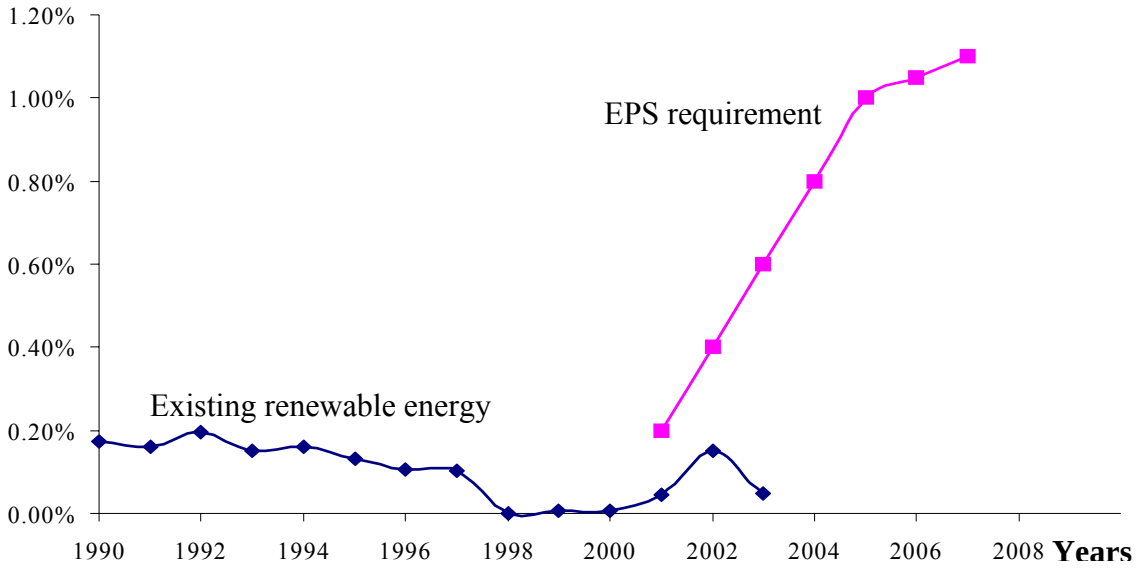
The CEWG proposed that the current rate of funding for the EPS is not enough to achieve the goal of providing 1.1% of the electricity portfolio from renewable sources. In order to succeed with the EPS, it is necessary to develop the most cost-effective technology solutions including solar, biomass, landfill gas, wind, and geothermal generation technologies (CEWG, 2003).

In January 2004, the ACC directed the Utilities Division Staff to propose changes to the existing EPS (ACC, 2005). The stakeholders throughout the state submitted comments and proposals regarding the changes to the EPS. Following key recommendations for changes to the EPS were proposed by the Utilities Division Staff as a result of the analysis:

- ✓ Increase the percentage requirement from 1.1% in 2007 to 5% by 2015 and to 15% by 2025
- ✓ Reduce the solar electricity requirement from 60% to 20%
- ✓ Add a new 25% requirement for distributed renewable energy
- ✓ Starting from 2006, 10% of the annual portfolio requirements should come from power purchase agreements resulting from open public bids or Request For Proposals. The requirement should increase to 40% in 2010
- ✓ Increase the funding levels for RPS: keep the $0.000875 per kWh charge, but increase the monthly caps to $2 for residential customers, $75 for small commercial customers, and $220 for large customers
- ✓ Eliminate the 2012 expiration date for RPS.

Figure 5.2 represents the renewable energy generation and the current status of EPS implementation in Arizona as a percentage share of total generated electric energy .

Figure 5.2. Renewable energy generation and EPS status in Arizona (EIA, 2004)



As it is evident from Figure 5.2 the EPS in Arizona did not achieve its percentage requirements during the three years of the policy implementation.

In order to determine the degree of RPS success in Arizona it is necessary to calculate the Target Setting, RPS Achievement, and RE Growth.

The share of renewable energy in the electricity portfolio of Arizona prior to the enactment of RPS in 2001 was RE_{E-1}=0.01%. The RPS requirement for the first year of the policy (2001) was $RPS_{1^{st}\ year}$=0.20%. The share of renewable energy in the electricity portfolio of Arizona in 2003 was $RE_{,03}$=0.05%. The RPS requirement for 2003 was $RPS_{,03}$=0.60%.

According to the equations 3.1-3.3:

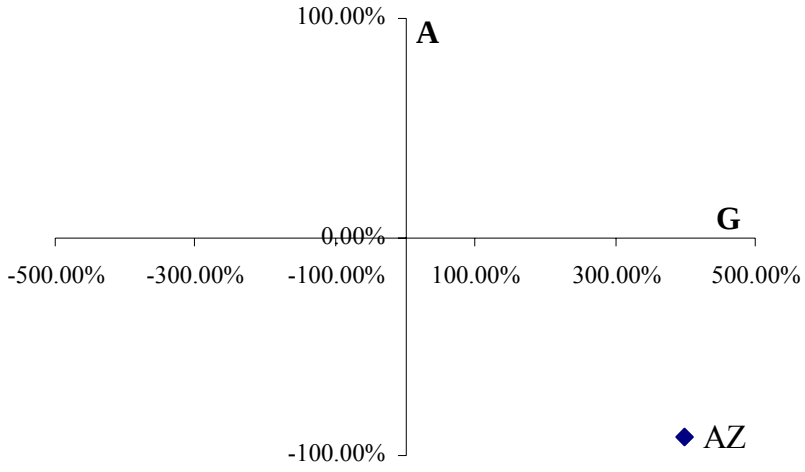
$$TS = 1900\%,$$

$$A = -91.67\%,$$

$$G = 400\%.$$

Figure 5.3 represents the A=f(G) function for Arizona.

Figure 5.3 The A=f(G) function for Arizona



As it is evident from Figure 5.3, and taking into consideration that the TS for Arizona is a positive number, the State achieved a High Medium success in implementation of the RPS. There was a significant growth of renewable energy used in the electricity portfolio of the State, but the RPS itself did not achieve its goals.

6. Hawaii Renewable Portfolio Standard

Overview

The Hawaii Renewable Portfolio Standard Law was originally enacted in 2001 (State of Hawaii, 2001), and later modified in 2004 (State of Hawaii, 2004). The purpose of the RPS in Hawaii is to reduce the dependence of the State on the imported oil, develop reliable energy system, increase the energy security, and reduce greenhouse gas emissions from energy use.

There was no evaluation conducted in order to estimate the public support for the policy, but there was a strong support for it from environmental groups and the renewable energy companies. The electric utility companies were opposed the implementation of the RPS due to concerns about practical ability to meet the requirements (Alber, 2005).

The electricity market in Hawaii is regulated by the Public Utilities Commission (PUC), which requires there to be only one provider for any particular "service territory" (PUC, 2004):

- ✓ Hawaiian Electric Company on Oahu Island
- ✓ Maui Electric on Maui Island, Molokai, and Lanai Islands
- ✓ Hawaii Electric Light Company on the Big Island
- ✓ Kauai Electric on Kauai Island.

Requirement

The current law on RPS requires that each electric utility company that sells electricity for consumption in the State to provide a certain percentage of their energy from renewable sources (State of Hawaii, 2005):

- 7% of its net electricity sales by December 31, 2003
- 8% of its net electricity sales by December 31, 2005
- 10% of its net electricity sales by December 31, 2010
- 15% of its net electricity sales by December 31, 2015
- 20% of its net electricity sales by December 31, 2020.

Funding

According to the current legislation, there is no specific funding for implementation of RPS (State of Hawaii, 2001).

Eligible Renewable Sources

The list of eligible renewable energy sources includes (PUC, 2004):

- ✓ Wind energy
- ✓ Solar energy
- ✓ Hydropower
- ✓ Landfill gas
- ✓ Waste to energy
- ✓ Geothermal resources
- ✓ Ocean thermal energy conversion
- ✓ Wave energy
- ✓ Biomass, including municipal solid waste
- ✓ Biofuel, or fuel derived from organic sources

- ✓ Hydrogen fuels derived from renewable energy or fuel cells where the fuel is derived from renewable sources.

REC Trading

The current RPS policy does not allow renewable energy credit trading between the electric utilities subject to the requirements (State of Hawaii, 2001).

Green Pricing

The law on RPS does not provide any specific regulation regarding the Green Pricing programs (State of Hawaii, 2001).

Import

Due to the geographical location of the State, import of electric energy from out-of-state generators is not considered o in the current RPS legislation (State of Hawaii, 2001).

Penalties

The RPS law in Hawaii is not mandatory, and there are not any penalties for noncompliance with the requirements. In case when the utility company does not meet the requirements of the law, it should report to the PUC within 90 days following the goal dates and provide an explanation for not meeting the RPS goal. The PUC determines if the utility company is unable to meet the requirements in a cost-effective way, or it is beyond its control to certain circumstances. If the PUC determines that the utility was unable to meet the requirements, it may be either relieved from responsibilities of meeting the requirements for

the period of time that it was unable to meet the standard, or it may be granted an extension for meeting the requirements (State of Hawaii, 2001).

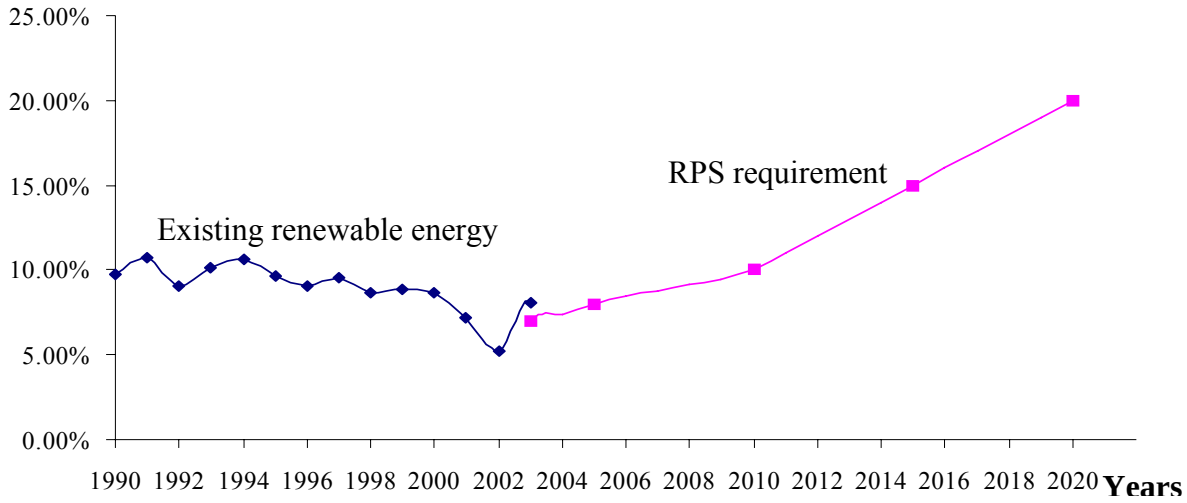
Criteria for RPS Success

The main criterion for measuring the success of the RPS implementation in Hawaii is whether the percentage requirements of the policy are achieved or not (Alber, 2005).

Current Status

Figure 6.1 represents the renewable energy generation and the current status of RPS implementation in Hawaii as a percentage share of total generated electric energy.

Figure 6.1. Renewable energy generation and RPS status in Hawaii (EIA, 2004)



From the Figure 6.1. it is evident that the RPS in Hawaii has achieved its goal of 7% in 2003, and even surpassed by 1.1%, thus achieving the 2005 goal also.

In order to determine the degree of RPS success in Hawaii it is necessary to calculate the Target Setting, RPS achievement, and RE Growth.

The share of renewable energy in the electricity portfolio of Hawaii prior to the enactment of RPS in 2001 was RE_{E-1}=8.69%. The RPS requirement for the first year of the policy (2003) was $RPS_{1^{st}\ year}$=7.00%. The share of renewable energy in the electricity portfolio of Hawaii in 2003 was $RE_{'03}$=8.10%. The RPS requirement for 2003 was $RPS_{'03}$=7.00%.

According to the equations 3.1-3.3:

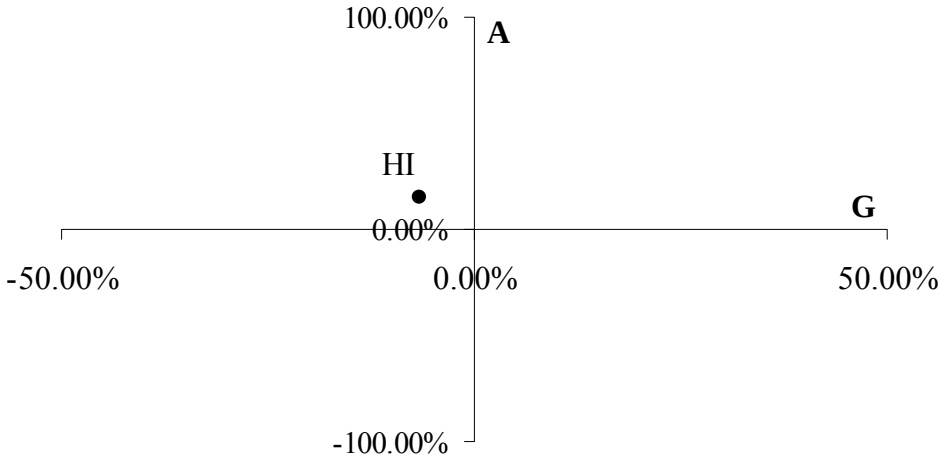
$$TS = -19.45\%,$$

$$A = 15.71\%,$$

$$G = -6.79\%.$$

Figure 6.2 represents the A=f(G) function for Hawaii.

Figure 5.3 The A=f(G) function for Hawaii



According to Figure 6.2, and taking into consideration that the TS for Hawaii is a negative number, the State achieved a Low Medium success in implementation of the RPS, because as a result of the policy there was not any growth in renewable energy, moreover, compared to the year before the RPS enactment, the amount of renewable energy in the

electricity portfolio of the State has decreased. But the policy itself has achieved its goal for the 2003.

7. Maine Renewable Portfolio Standard

Overview

As a part of restructuring the electricity market starting in March, 2000, Maine enacted the Renewable Resource Portfolio Requirement (typically referred as RPS) in September, 1999 (REPP, 2004). The primary goals and objectives of the RPS are (PUC, 2005):

- ✓ Environmental benefits from using more renewable resources, with respect to air emissions
- ✓ Diversification of energy generation sources, thus decrease of reliance on conventional fuels
- ✓ Increase of energy security by reducing the reliance on imported fuels
- ✓ Economic benefits through creation of new jobs through further development of renewable resources.

According to the PUC the RPS in Maine was mostly politically driven, under the influence of environmental groups and the renewable energy supporters. The public opinion was not evaluated prior to the enactment of the policy. The electric utility companies did not oppose the RPS during the legislative process (Tannenbaum, 2005).

Requirement

The RPS in Maine requires each electricity provider to supply not less than 30% of its total kilowatt-hour sales to customers in Maine with electric energy generated from eligible resources, starting from November 4, 1999. The RPS is administered by the Maine Public Utilities Commission (REPP, 2004).

Funding

The funding for implementation of RPS requirements in Maine comes from kWh charges included in electricity rates (REPP, 2004).

Eligible Renewable Sources

The list of eligible renewable energy sources includes (PUC, 2005):

- ✓ Fuel cells
- ✓ Tidal power
- ✓ Solar arrays and installations
- ✓ Wind power installations
- ✓ Geothermal installations
- ✓ Hydroelectric generators
- ✓ Biomass generators
- ✓ Generators fueled by municipal solid waste in conjunction with recycling.

Besides the requirements for eligibility of energy sources, the RPS also requires eligible technologies to be:

- ✓ Sustainable – inexhaustible or replaceable.
- ✓ Clean - from the environmental perspective. Those are not necessarily renewable energy technologies, but also those using conventional fuels, but with reduced air emissions and environmental damage.
- ✓ Efficient – with high energy output compared to the energy input.

REC Trading

There are not RECs created under the RPS, and the trading of renewable energy credits is not allowed according to the RPS policy. Each electricity provider should meet the 30% renewable energy generation requirement individually (REPP, 2004).

Green Pricing

Electricity generated ad sold as a result of Green Pricing program is not counted towards the RPS requirement. If an electricity provider supplies to a certain customer a portfolio of sources that includes more than 30% of renewable energy, that surplus of renewable energy load can not be counted towards the aggregate RPS requirement of that provider (REPP, 2004).

Import

The RPS allows out-of-state import of electric energy generated from eligible renewable energy sources, in order to qualify for the requirements, but the energy should be delivered physically to the control area of Independent System Operator of New England or the Maritimes control area (REPP, 2004).

Penalties

The policy does not provide penalties for non-compliance with the requirements. An electricity provider that does not meet the 30% requirement during the compliance period of one year, but provided at least 20% of its electricity from eligible renewable resources, can make up the deficiency during the next compliance period, so that during the two compliance

periods the total kilowatt-hour sales contained not less than 30% of energy generated from eligible renewable resources (REPP, 2004).

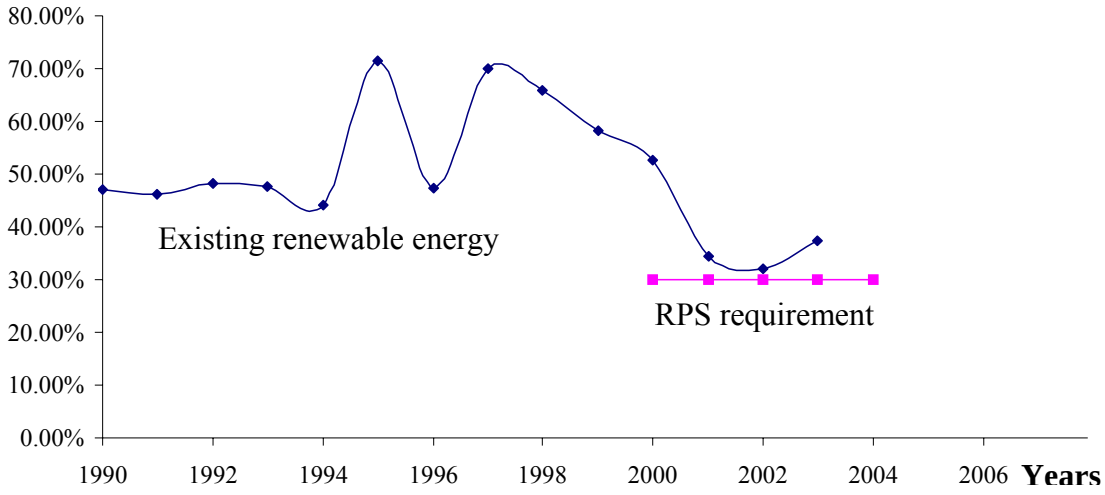
Criteria for RPS Success

The main criterion for measuring a success of the RPS policy in Maine is whether the percentage requirements are met in the particular year (Tannenbaum, 2005).

Current Status

According to the Figure 7.1 the percentage goals of RPS during the years of implementation of the policy were met.

Figure 7.1. Renewable energy generation and RPS status in Maine (EIA, 2004)



As the electricity portfolio of Maine includes more than 30% of electricity generated from eligible renewable sources, the RPS goal of increasing the share of renewable energy in the portfolio of the state can not be achieved. There is more renewable energy supplied in the state than there is demand for it caused by the RPS itself (Tannenbaum, 2005).

In order to determine the degree of RPS success in Maine it is necessary to calculate the Target Setting, RPS achievement, and RE Growth.

The share of renewable energy in the electricity portfolio of Maine prior to the enactment of RPS 1999 was RE_{E-1}=65.99%. The RPS requirement for the first year of the policy (2000) was $RPS_{1^{st}\ year}$=30.00%. The share of renewable energy in the electricity portfolio of Maine in 2003 was $RE_{,03}$=37.33%. The RPS requirement for 2003 was $RPS_{,03}$=30.00%.

According to the equations 3.1-3.3:

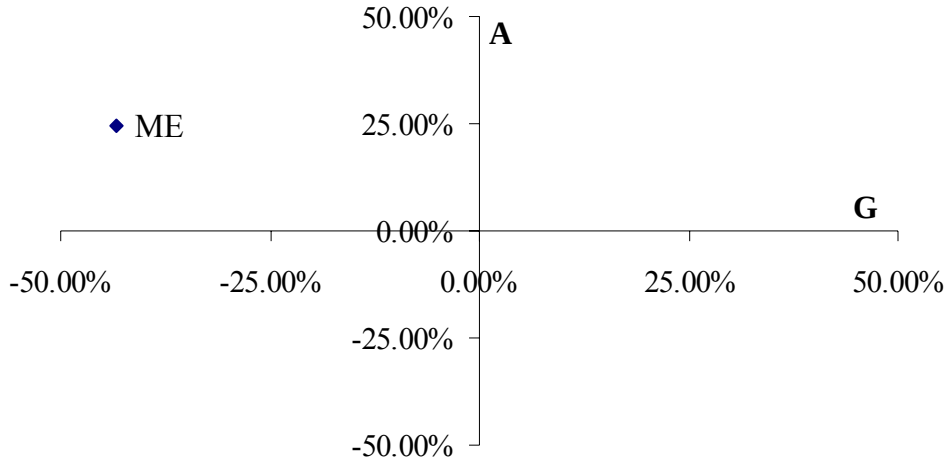
$$TS = -54.54\%,$$

$$A = 24.43\%,$$

$$G = -43.43\%.$$

Figure 7.2 represents the A=f(G) function for Maine.

Figure 7.2 The A=f(G) function for Maine



Based on Figure 7.2, and taking into consideration that the TS for Maine is a negative number, the State achieved a Low Medium success in implementation of the RPS, because as a result of the policy there was not any growth in renewable energy, moreover, compared to

the year before the RPS enactment, the amount of renewable energy in the electricity portfolio of the State has decreased. But the policy itself has achieved its goal for the 2003.

8. Texas Renewable Portfolio Standard

Overview

In 1999 the Texas government approved implementation of the RPS policy, called Goal for Renewable Energy that was a part of restructuring of the state's electricity market. It was one of the "environmentally-friendly" aspects of the deregulation, that was a result of compromise between different stakeholders, in order to pass the deregulation legislation (Schubert, 2005). The RPS was intended to encourage the development of new renewable resources and thus reduce the environmental impacts of electricity production and also to contribute to development of rural areas by creating renewable energy business opportunities.

There was some resistance towards the RPS from the big electricity utilities, and large industrial customers, who were afraid of increasing prices for the electricity as a result of the policy (Wiser, Langniss, 2003). The renewable energy representatives were supporting the RPS actively. The public surveys that were conducted by the Texas Public Utilities Commission (PUC), showed that there was a significant public support for renewable energy (Schubert, 2005).

Requirement

The RPS began in January 2002, and required installation of 2000 MW of new renewable generation capacity by the year 2009. This translates into approximately 3% of the total electricity consumption in Texas in 2002 (Wiser, Langniss, 2003). The RPS obligation is placed on all electricity retailers in competitive market, which represents almost 80% of total Texas electricity providers. The initial renewable energy share in the electricity

portfolio of Texas in 2002 was 880 MW. The schedule of adding the new renewable energy capacities is presented in the Table 8.1. (PUC, 1999).

Table 8.1. New renewable energy capacities schedule according to the RPS.

Year	New renewable energy capacity
2002	400 MW
2003	400 MW
2004	850 MW
2005	850 MW
2006	1400 MW
2007	1400 MW
2008	2000 MW
2009-2019	2000 MW

Funding

There is no specific funding designed for RPS implementation besides the kWh charges through electricity rates (REPP, 2004).

Eligible Renewable Sources

Only new renewable energy generation facilities, built after September 1, 1999 are eligible for the policy. The exception is given to the renewable power plants with a capacity smaller than 2MW.

The list of eligible renewable energy sources includes:

- ✓ Solar photovoltaic
- ✓ Wind
- ✓ Geothermal
- ✓ Hydropower

- ✓ Wave/tidal energy
- ✓ Biomass or biomass-based waste products,
- ✓ Landfill gas.

According to the RPS requirements, utilities can purchase renewable energy from power plants that are larger than 2MW and built before September 1, 1999 which is counted towards REC obligation, but are not tradable.

REC Trading

In order to comply with the RPS requirements the electricity retailers have to either purchase or generate renewable energy, which should be certified as a renewable energy credit (REC) representing one megawatt per hour of renewable energy that is physically metered and verified in Texas according to the eligibility requirements of RPS. There is a capacity conversion factor (CCF) used by the program administrator to allocate credits to competitive retailers. The CCF for 2002 and 2003 was 35%. During the fourth quarter of 2003 the CCF should have been readjusted to reflect the actual generator performance data associated with all renewable resources in the trading program. According to the policy requirements, the program administrator has to adjust the CCF every two years during the policy implementation period (REPP, 2004). The RPS requires the electricity retailers to comply with their megawatt obligation based on their proportionate yearly retail electricity sales, by presenting RECs to the administering authorities – the Texas PUC and the Electric reliability Council of Texas (ERCOT). ERCOT is appointed by the PUC to administers the REC trading system.

According to the policy, RECs are tradable units and there is not a price cap for those. RECs may be traded, transferred and retired. In order to generate renewable energy that can be traded as a REC, the generating facility should be certified by the PUC. RECs have a useful life time of three Compliance Periods. The Compliance Period is the calendar year beginning January 1 and ending December 31 of each year in which renewable energy credits are required from a Competitive Retailer (ERCOT, 2001). ERCOT maintains records of generated RECs and administers their trading. All market participants have their individual accounts in the database that is administered by ERCOT. Each quarter the RECs generators report about the MWh amount of generated energy and ERCOT assigns those RECs to the generator's individual account. When an electricity retailer (purchaser) and a REC owner put a request, ERCOT transfers the RECs from the owner's account to the account of the purchaser (ERCOT, 2001).

Green Pricing

Renewable energy generation capacity under Green Pricing programs is eligible for compliance with the RPS requirements (REPP, 2004).

Import

Imported electric energy generated from eligible renewable sources that is metered and sold in Texas is eligible for compliance with the RPS requirements (REPP, 2004).

Penalties

If any of the retailers do not meet their obligations under RPS for the compliance period, ERCOT informs PUC about that. There is a three months grace period after compliance period allowed to fulfill the obligations. The policy provides penalties for non-compliance with the requirements equal to the lesser of 5 (US) ¢ or 200% of mean REC trade value in compliance period for each missing kWh (Wiser, Langniss, 2003).

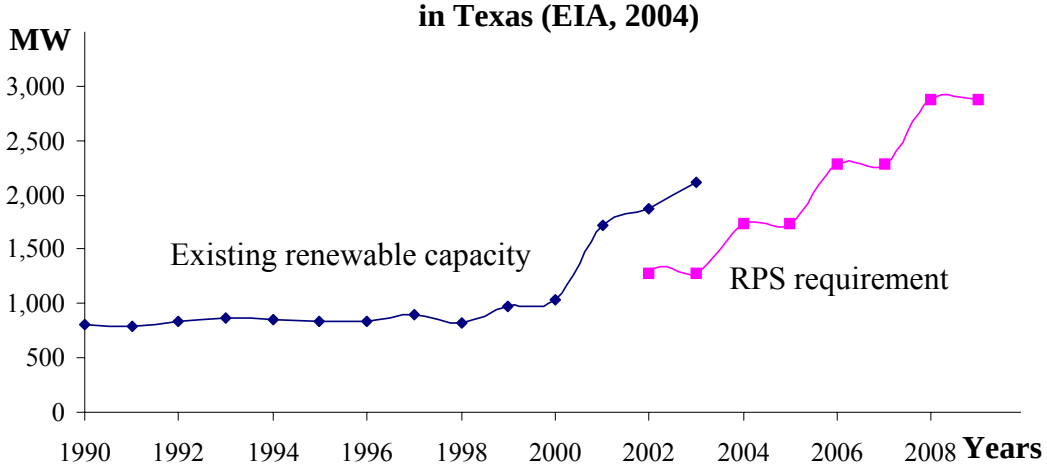
Criteria for RPS Success

The main criterion for measuring the success of RPS in Texas is whether the capacity requirements of the policy are achieved or not (Schubert, 2005).

Current Status

Figure 8.1 represents the existing renewable energy generation capacities and the RPS requirements in Texas. It is evident that the capacity requirements of RPS in 2002 and 2003 were met and surpassed. Figure 8.1 also shows that the 2004 requirements were also met in year 2003.

Figure 8.1. Renewable energy generation capacity and RPS status in Texas (EIA, 2004)



Currently Texas is considering changes to the existing RPS and there are proposals for increasing the RPS goal to 5,000-10,000 MW in the next ten to twenty years (Schubert, 2005).

In order to determine the degree of RPS success in Texas it is necessary to calculate the Target Setting, RPS achievement, and RE Growth.

In order to apply the developed RPS Metric System for the case of Texas, the MW capacity requirements were transferred into percentages of renewable energy generation capacities from the total generation capacity of the State based on the data provided by EIA (2004).

The share of renewable energy generation capacity in the total electricity generation capacity of Texas prior to the enactment of RPS in 1999 was $RE_{E\text{-}1}$=1.06%. The RPS requirement for the first year of the policy (2002) was $RPS_{1^{st}\ year}$=1.26%. The share of renewable energy in the electricity portfolio of Texas in 2003 was $RE_{'03}$=1.95%. The RPS requirement for 2003 as a share of total electricity generation capacity was $RPS_{'03}$=1.18%.

According to the equations 3.1-3.3:

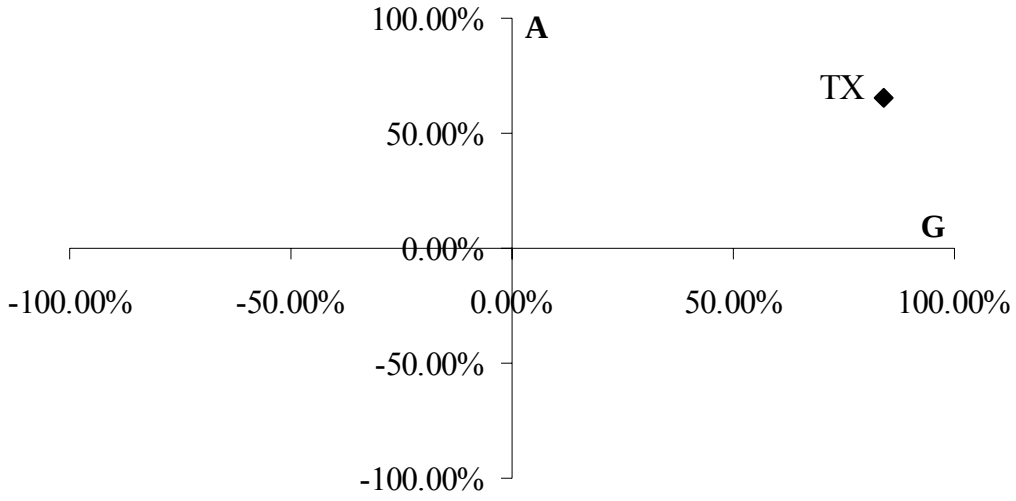
$$TS = 18.87\%,$$

$$A = 65.25\%,$$

$$G = 83.96\%.$$

Figure 8.2 represents the A=f(G) function for Maine.

Figure 8.2 The A=f(G) function for Texas



Based on Figure 8.2, and taking into consideration that the TS for Texas is a positive number, the State achieved a High success in implementation of the RPS, because as a result of the policy there was a significant growth in renewable energy generation capacity, and the policy achieved and surpassed its goals for 2003 as well.

9. Wisconsin Renewable Portfolio Standard

Overview

In October 27, 1999, Wisconsin adopted the RPS, which made it the first state in U.S. to have an RPS (Database of State Incentives for Renewable Energy (DSIRE), 2004).

The RPS was mainly driven by political forces in Wisconsin. According to Public Service Commission (PSC) there was a strong support for RPS from the public, which was determined through surveys, as well as from the renewable energy representatives. The reaction of electricity utilities was not favorable, with active lobbying during the legislative process, which resulted in lower RPS requirements than was originally designed (Helgeson, 2005).

Requirement

The RPS legislation in Wisconsin included a two-part requirement (REPP, 2003):

1. Capacity Requirement for the utilities in eastern Wisconsin to install a total of 50 MW of new renewable based electricity production by December 31, 2000. The share of each utility in meeting the requirement was determined by the Public Utility Commission. As a result of this requirement the following generation facilities were installed:

   - ✓ Rosier Wind Farm - 11 MW generation capacity in 1999
   - ✓ Lincoln Wind Farm - 9 MW generation capacity in 1999
   - ✓ Iowa County Wind Farm - 30 MW generation capacity in 2001.

2. Generation Requirement to provide 2.2% of total retail electric energy in Wisconsin by 2012 from renewable sources. The percentage growth of the requirement is presented in Table 9.1.

Table 9.1. Percentage growth of RPS requirement per year.

Year	Percentage requirement, %
2001	0.50 %
2003	0.85 %
2005	1.20 %
2007	1.55 %
2009	1.90 %
2011	2.20 %

The Division of Energy of Wisconsin Department of Administration is the administering entity of the RPS implementation. The reporting is done by each electricity provider annually no later than April 15, describing the compliance with the RPS (REPP, 2003).

Funding

The costs of complying with the RPS requirements are covered through the retail electricity rates. In order to avoid a drastic increase of electricity prices, the electricity rates are coordinated with the Department of Administration to be prudently incurred by the utility to comply with the RPS requirements.

Eligible Renewable Sources

According to the requirements of the RPS only renewable energy generation facilities that were installed on or after January 1, 1998 are eligible.

The list of eligible renewable energy sources includes (REPP, 2003):

- ✓ Biomass (except non-vegetation-based industrial, commercial, or household waste)
- ✓ Biomass co-firing
- ✓ Fuel cell with renewable fuel
- ✓ Geothermal technology
- ✓ Hydroelectric generation facilities (<60 MW)
- ✓ Solar thermal electric
- ✓ Solar photovoltaic
- ✓ Tidal or wave power
- ✓ Wind power.

RRC Trading

In order to comply wit the RPS requirements the electric utilities are allowed to trade renewable resource credits (RRC), representing one megawatt per hour of electric energy generated from eligible sources. The accounting for the RRC trading is due the February 15th each year. Every electricity provider that participates in the RRC trading by creating an RRC should report to the program administrator the amount of renewable energy it generated or purchased from each certified renewable facility, and sold at retail during the preceding year. The state legislation provides certification for the RRCs. The program administrator may establish a procedure to ensure that the creation, sale, transfer, purchase and retirement of

RRCs are accurately recorded. Banking of RRCs for future is allowed, and the banked RRCs are valid through the whole period of RPS implementation (REPP, 2003).

Green Pricing

Funds collected through the Green Pricing programs are allowed to be used for covering the expenses associated with the RPS implementation (REPP, 2003).

Import

Importing of out-of-state electric energy generated from eligible renewable sources is allowed under the RPS legislation as long as the electricity is physically delivered to the state and sold at retail (REPP, 2003).

Net metering is allowed for generations systems up to 20 kW for customers of investor-owned utilities. The utility must pay retail rates for net excess generation. The net-metered renewable generation facilities are eligible under the RPS as long as the generation can be tracked and verified through dual metering system.

Penalties

Penalties are provided for any person that violates the RPS legislation, or any wholesale supplier who provides an electric provider with a false or misleading certification regarding the sources or amounts of energy generated from renewable sources. The amounts of penalties are not less than $5,000 and not more than $500,000 and are enforced by action on behalf of the state by the attorney general (REPP, 2003).

Criteria for RPS Success

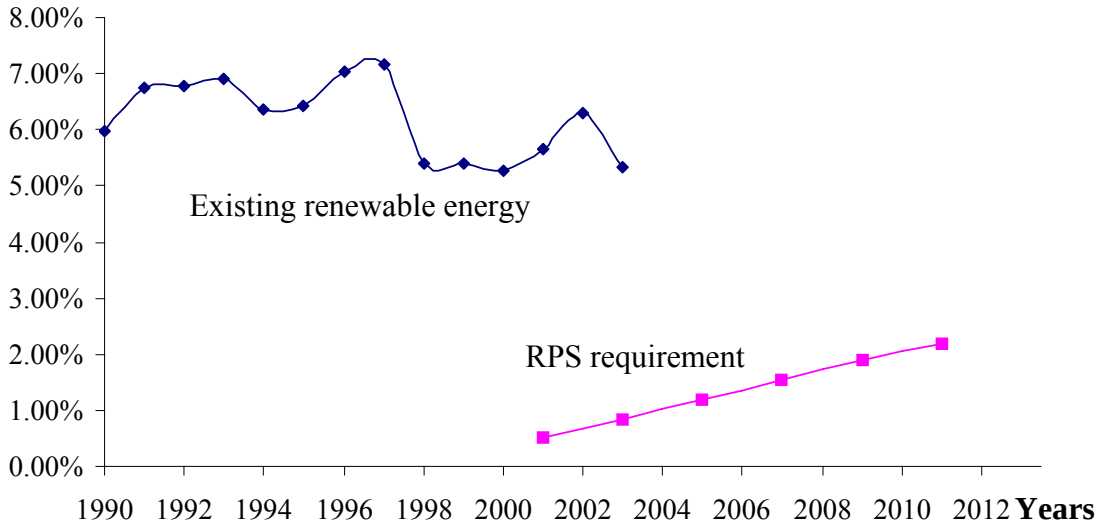
According to the PSC of Wisconsin the criteria for measuring the success of RPS implementation are:

- ✓ Achieving the percentage goals of the policy
- ✓ Response of electric utilities and the renewable energy developers.

Current Status

Figure 9.1 represents the existing share of electricity generation from eligible renewable sources and the RPS requirement as percentages from the total electricity portfolio:

Figure 9.1. Renewable energy generation and RPS status in Wisconsin (EIA, 2004)



As it is evident from the Figure 9.1 the current share of renewable energy in the electricity portfolio of Wisconsin is much more than the RPS requirement, thus the policy is considered a success based on the criterion of achieving the percentage goals.

In order to determine the degree of RPS success in Wisconsin it is necessary to calculate the Target Setting, RPS achievement, and RE Growth.

The share of renewable energy in the electricity portfolio of Wisconsin prior to the enactment of RPS 1999 was RE_{E-1}=5.40%. The RPS requirement for the first year of the policy (2001) was $RPS_{1^{st}\ year}$=0.50%. The share of renewable energy in the electricity portfolio of Wisconsin in 2003 was $RE_{,03}$=5.34%. The RPS requirement for 2003 was $RPS_{,03}$=0.85%.

According to the equations 3.1-3.3:

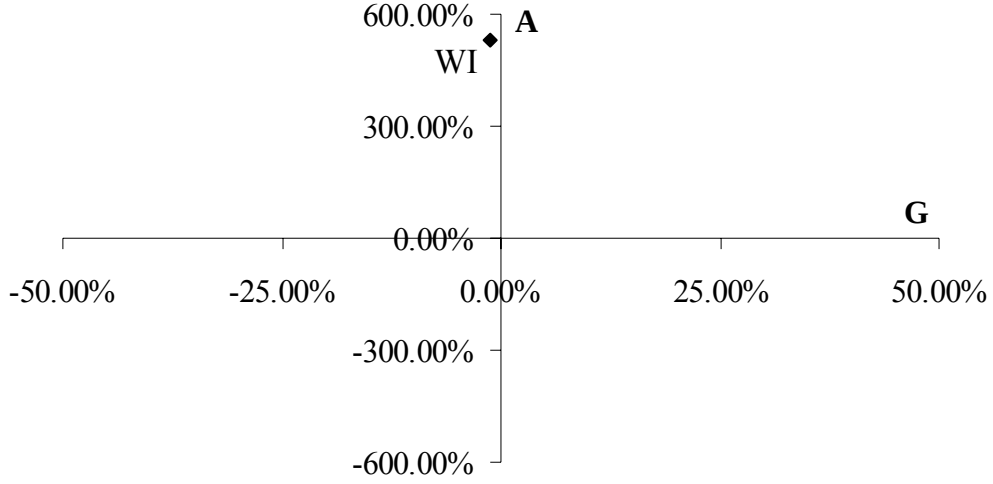
$$TS = -90.74\%,$$

$$A = 528.24\%,$$

$$G = -1.11\%.$$

Figure 9.2 represents the A=f(G) function for Wisconsin.

Figure 7.2 The A=f(G) function for Wisconsin



Based on Figure 9.2, and taking into consideration that the TS for Wisconsin is a negative number, the State achieved a Low Medium success in implementation of the RPS, because as a result of the policy there was not any growth in renewable energy, moreover, compared to the year before the RPS enactment, the amount of renewable energy in the electricity portfolio of the State has decreased. But the policy itself has achieved its goal for the 2003.

10. Cross-Case Analysis

The analysis of the RPS implementation in the case-states was done based on both quantitative and qualitative criteria. In order to determine and evaluate the non-quantitative aspects of the policy a survey was conducted. The participants of the survey were the representatives of the Public Utilities Commissions in the case-states. The survey asked the participants to identify the following aspects of the RPS in the case-states:

- ✓ What were the driving forces behind the policy?
- ✓ What were the goals of the RPS besides the energy security and environmental goals?
- ✓ Whether there was a public support for the policy or not?
- ✓ Whether there was a support of Electric Utilities for the policy?
- ✓ Whether there was a support of Renewable Energy Representatives for the policy?

The survey also asked the participants to identify the criteria for measuring a success of RPS in their states and also to define whether there was a success or not. According to the results of the survey the main criteria for measuring the success of an RPS is the achievement of the actual requirements of the policy, whether it is a percentage or capacity requirement. Other criteria included:

- ✓ Cost-effectiveness of renewable energy generation
- ✓ Growth and improvement in the private sector of renewable energy companies.

In order to conduct a cross-state analysis of RPS design and implementation a comparison matrix was built – Table 10.1.

Table 10.1 Analysis matrix of the case-states

	Arizona		Hawaii		Maine		Texas		Wisconsin	
RPS Enacted	2001		2001, 2004		1999		1999		1999	
Driving forces	Environmental		Environmental, economic		Political		Political		Political	
Public support	Yes		N/A		N/A		Yes		Yes	
Utilities support	No		No		Yes		No		No	
Renewables' support	Yes		Yes		Yes		Yes		Yes	
Time period	2001-2012		2003-2020		5 years, then review		2002-2019		2001-2011	
Requirement type	mandatory		voluntary		mandatory		mandatory		mandatory	
Requirement	2001	0.20%	2003	7%	2000	30%	2002	new 400 MW	2001	0.50%
	2002	0.40%	2005	8%	2001	30%	2003	new 400 MW	2003	0.85%
	2003	0.60%	2010	1%	2002	30%	2004	new 850 MW	2005	1.20%
	2004	0.80%	2015	15%	2003	30%	2005	new 850 MW	2007	1.55%
	2005	1.00%	2020	20%	2004	30%	2006	new 1400 MW	2009	1.90%
	2006	1.05%					2007	new 1400 MW	2011	2.20%
	2007-2012	1.10%					2008	new 2000 MW		
							2009-2019	new 2000 MW		
Target Setting	1900.00%		-19.45%		-54.54%		18.87%		-90.74%	
Eligible resources	Solar photovoltaic, solar thermal electric, solar water heating systems, solar air conditioning systems, in-state landfill gas generators, in-state wind generators, in-state biomass generators, small hydro-electric generation, waste generation.		Wind, solar, hydropower, landfill gas, waste to energy, geothermal, ocean thermal energy conversion, wave energy, biomass, municipal solid waste, biofuel, hydrogen fuels derived from renewable energy or fuel cells where the fuel is derived from renewable sources.		Fuel cells, tidal power, solar arrays and installations, wind power installations, geothermal installations, hydroelectric generators, biomass generators, generators fueled by municipal solid waste in conjunction with recycling.		Solar photovoltaic, wind, geothermal, hydro power, wave/tidal energy, biomass or biomass-based waste products, landfill gas.		Biomass, biomass co-firing, fuel cell with renewable fuel, geothermal technology, hydroelectric generation facilities (<60 MW), solar thermal electric, solar photovoltaic, tidal or wave power, wind power.	

Table 10.1 Continued

	Arizona		Hawaii	Maine	Texas	Wisconsin
Funding	0.000875 per kWh for all customers		No	Through electricity rates	Through electricity rates	Through electricity rates
REC trading	Yes		No	No	Yes	Yes
Green Pricing	Yes		No	No	Yes	Yes
Cost cap	Residential	$0.35	N/A	No	No	No
	Non-residential	$13.00				
	Non-residential with metered demand 3,000 kW or more for 3 consecutive months	$39.00				
Import	Only solar energy		No	Yes	Yes	Yes
Penalties	No		No	No	Yes	Yes
Success	**High Medium**		**Low Medium**	**Low Medium**	**High**	**Low Medium**

Driving forces of RPS

One of the main criteria of RPS policy is whether the adoption of the policy was a mainly political or environmentally driven decision.

The RPS in Arizona was driven by environmental concerns (Williamson, 2005), and it was aimed to develop renewable energy market in order to reduce the greenhouse gases emissions due to the electricity generation from conventional sources. As it is evident from the Figure 5.2 the RPS in Arizona did not achieve the required 0.20% in 2001, 0.40% in 2002, and 0.60% in 2003 (EIA, 2004). Besides the fact that the goals were set high, it was also required that during 2001-2003, at least 50% of all electricity generated from eligible renewable sources should be from solar energy, and starting from 2004 at least 60% of it should be from solar energy. This provided barriers for other renewable energy types to develop and constitute to the RPS requirements. Another factor that limited the success of RPS was the fact that there was not sufficient funding for the policy, and it was not possible for the electric utility companies to achieve a cost-effective compliance with the policy requirements (CEWG, 2003).

The RPS in Hawaii was driven by environmental and economical concerns (Alber, 2005). It was aimed to reduce the dependence of the State on the imported oil, develop reliable energy system, increase the energy security, and reduce greenhouse gas emissions from energy supply and use. The policy achieved its goal of 7% of total electricity sales to be generated from eligible renewable energy sources in 2003 – Figure 6.1. It is necessary to mention that the short period of the policy implementation and absence of data for the year 2004 put limitations on the evaluation of the policy. The RPS in Hawaii is considered a Low Medium success, based on the RPS Metric System.

The RPS in Maine was mainly a political decision, according to the PUC (Tannenbaum, 2005). The RPS in Maine requires that each electricity provider to supply no less than 30% of its total kilowatt-hour sales to customers in Maine with electric energy generated from eligible resources, starting from November 4, 1999. When compared to the electricity generated from eligible renewable sources in 1998 – 65.99% and 1999 – 58.25%, the requirement of 30% in 2000 does not seem appropriate to stimulate the development of renewable energy market, which is the most important goal of the policy. The Figure 7.1 shows that the generated renewable energy during 2000-2003 was always more than the 30% requirement. According to PUC the RPS in Maine never stimulated development of renewable energy generation market, as the demand caused by RPS was always lower than the actual supply of electricity generated from eligible renewable sources (Survey, 2005). The RPS in Maine is considered a Low Medium success, based on the RPS Metric System.

The RPS in Texas was driven by political motives (Schubert, 2005). The goals of the policy were very modest as the requirement of new 2000 MW of renewable energy generation capacity by year 2009, constituted to only approximately 2.2% of the total existing electricity generation capacity in 2009 (Wiser, Langniss, 2003). The RPS was part of the electric market deregulation legislation, and was a result of a compromise between the electric utility companies and environmental groups. After the adoption of RPS in 1999, the renewable energy generation capacities, mostly wind energy generation facilities, increased significantly.

It is necessary to mention for the case of Texas, that there were a number of aspects that stimulated such a fast development of the renewable energy generation capacities in Texas. The resource potential of wind energy in Texas is about 500% of the state's current

electricity consumption (Texas State Energy Conservation Office, 2005). Beside the abundant resources potential for wind power, there is also a federal 1.7 cent/kWh production tax credit (PTC), that makes the wind power one of the most competitive of all RPS-eligible renewable energy sources in Texas. Thus, the RPS in Texas achieved a High success, being a politically driven policy according to the survey results and the data presented in Figure 8.1.

The RPS in Wisconsin was driven by political motives (Helgeson, 2005). It requires provision of 0.50 % of the total retail electricity in 2001 from eligible renewable sources; 0.85 % in 2003; 1.20 % in 2005; 1.55% in 2007; 1.90% in 2009; and 2.20% in 2011. When compared to the electricity generated in Wisconsin from eligible renewable energy sources: 2.01% in 1999, 1.93% in 2000, 2.15% in 2001, 1.99% in 2002, and 2.27% in 2003 the RPS requirements do not stimulate the development of renewable energy market – the primary goal of the policy (Figure 9.1). It is evident that the driving forces for the RPS in Wisconsin were clearly political, and did not pursue environmental benefits form the development of renewable energy.

RPS requirement type

Another important aspect of the policy that affected implementation of RPS is whether the requirements are mandatory or voluntary. The logic dictates that the mandatory requirements are more likely to lead to a success of a policy than voluntary requirements. The mandatory requirements usually provide also a set of penalties that further enforce the implementation of the policy.

From the point of RPS implementation, mandatory requirements are more likely to lead to compliance. This is because the compliance means that the electricity provider should invest into renewable energy generation, and, most likely, it will not be desired much.

Eligible renewable energy sources

The eligible renewable energy sources are a very important constituent of the RPS design and implementation. One of the most important issues regarding the list of eligible sources is inclusion of hydropower in it.

As it is evident from the figures 10.1, 10.2 and 10.3 the hydroelectric facilities constitute to the biggest part of the total renewable energy generated in Maine, Texas and Wisconsin. There is a maximal capacity cap of 60 MW on hydroelectric generation facilities in Wisconsin, but most of the facilities are under that capacity cap.

Figure 10.1 Total renewable energy and hydroelectric energy generation in Maine (EIA, 2004)

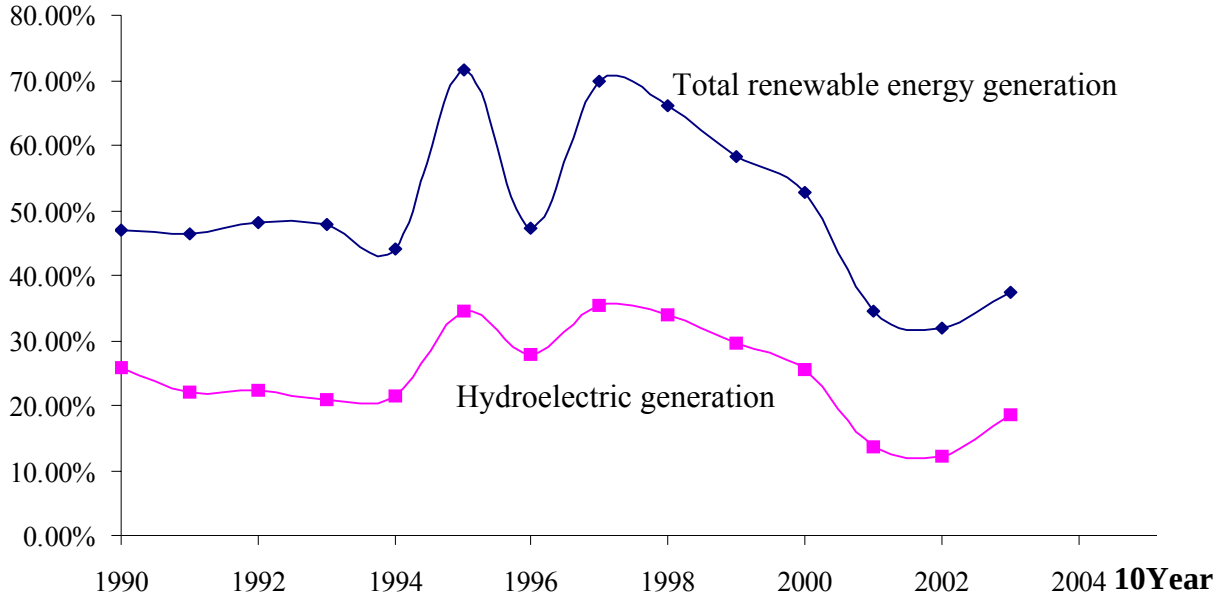


Figure 10.2 Total renewable energy and hydroelectric energy generation in Texas (EIA, 2004)

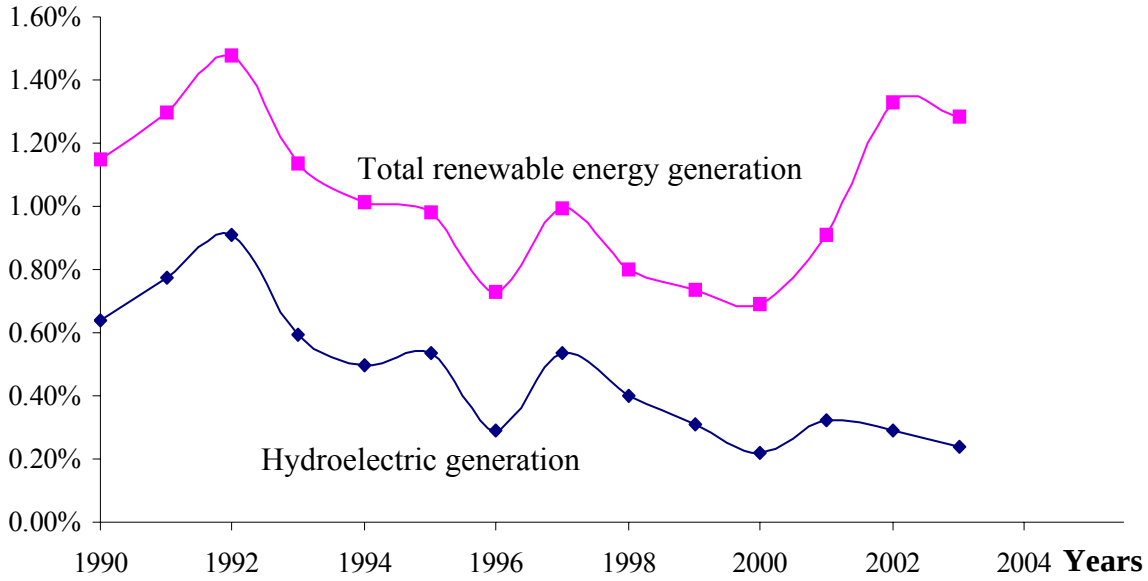


Figure 10.3 Total renewable energy and hydroelectric energy generation in Wisconsin (EIA, 2004)

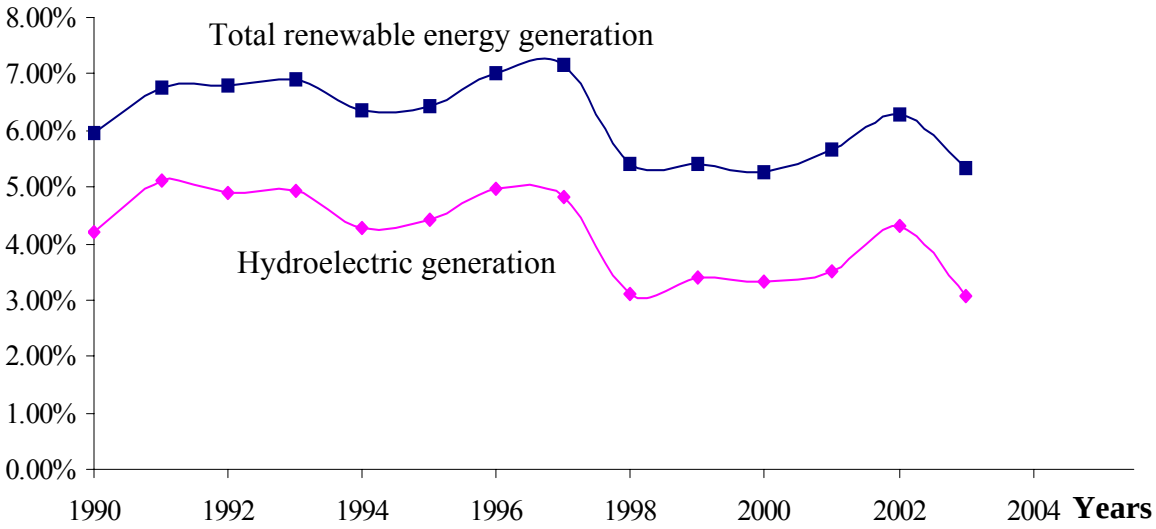
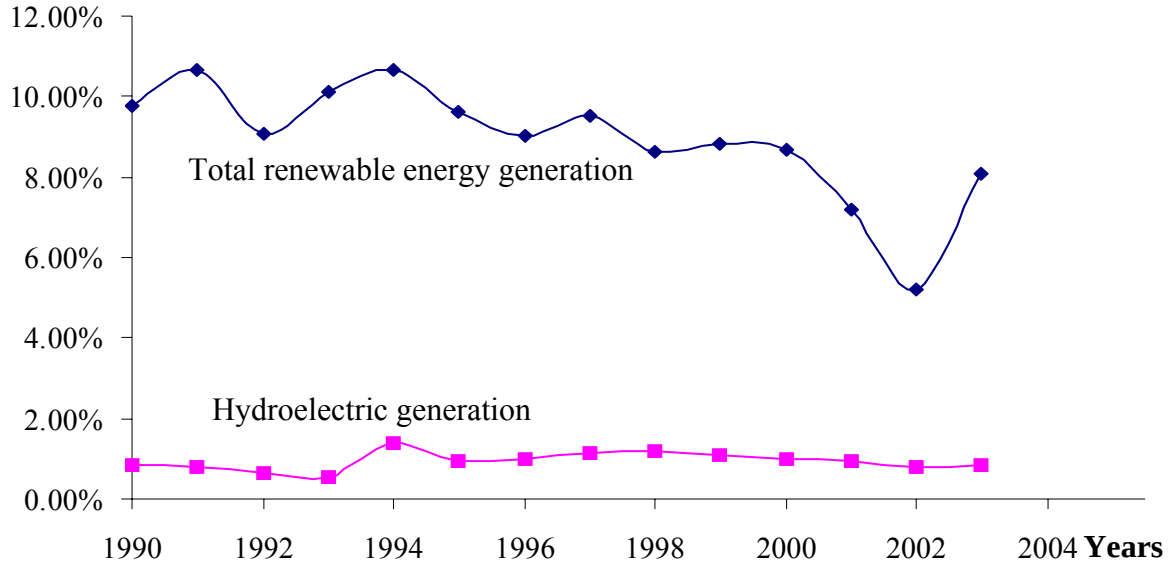


Figure 10.4 represents the total renewable energy and hydroelectric energy generated in Hawaii. Hydroelectric generation does not constitute to the biggest part of the renewable energy generated in Hawaii. It constituted to only 0.53% of the total electricity generated in Hawaii in 2003. Most of the eligible renewable energy sources in 2003 were Municipal Solid Waste – 3.50% of total electricity generated in state, Solar Water Heating – 1.62%, and Geothermal – 1.67%.

Figure 10.4 Total renewable energy and hydroelectric energy generation in Hawaii (EIA, 2004)



RPS funding

Another critical component of the RPS policy is provision of funding for the electric utilities to comply with the policy requirements. Table 10.1 shows that funding was available

in Arizona, Maine, Texas and Wisconsin through the kWh electricity rates. The only state that did not provide funding for RPS is Hawaii.

In case of Arizona the funding level was not sufficient in order for the electric utility companies to comply with the RPS requirements in a cost-effective way (CEWG, 2003).

REC trading

Renewable Energy Credit trading is another important component of an RPS policy. According to Table 10.1 Arizona, Texas, and Wisconsin included REC trading in the RPS design.

There is no evident correlation between the inclusion of REC trading in the design of RPS and achieving a success of the policy. Nevertheless, REC trading is very important for achieving a success of the policy. It provides flexibility for the entities affected by the RPS to comply with the requirements of the policy.

Green Pricing

Considering the electric energy generated from eligible renewable sources and sold to the customers under the Green Pricing policy towards compliance with the RPS requirements makes it easier for the electric utility companies to comply with the policy. The Green Pricing is a policy of providing the customers with electricity generated from renewable energy sources for a certain premium included in the kWh electricity rate. This is a separate policy from RPS, and considering it a part of the makes it easier for the utility companies to comply with the RPS requirements.

There is not an evident correlation between considering Green Pricing as a part of RPS requirement, and achieving a success of the policy.

Import

Import of eligible renewable energy from other states is another important constituent of an RPS policy.

Maine, Texas and Wisconsin allowed import of out-of-state electric energy generated from eligible renewable sources, thus making the compliance with the RPS requirements easier for the electric utility companies, that can not generate the electricity from eligible renewable sources in the state.

Arizona RPS has restrictions for imported electric energy to be generated only from solar energy. It could be more beneficial for the RPS policy in Arizona to consider import of electric energy generated from another eligible renewable sources. This could help the state to achieve a success of the RPS.

Hawaii did not allow import of electric energy from out-of-state due to the geographic location of the state.

Penalties

Provision of penalties for non-compliance with the requirements of the RPS is a very important constituent of the policy. Table 10.1 shows that Texas and Wisconsin have penalties for non-compliance with the RPS requirements. The Table 10.1 does not show an evident correlation between the provision of penalties for non-compliance with the RPS requirements and achieving a success of the policy.

Conclusion

In order to define the critical components of RPS design that lead to a success of the policy a cross-case comparison of the policy was implemented. The case of Texas RPS was taken as a benchmark for cross-case comparison, as the policy in this states have achieved a high success. It is necessary to take into account the uniqueness of the RPS in Texas when taking it as a benchmark for the cross-case comparison. One of the most important issues that needs to be considered is that the RPS requirement in Texas is very modest. According to estimates of Department of Energy the wind power alone in Texas had resource potential to deliver over 400% of the state's electricity consumption in 2001 (Wiser, Langniss, 2001). When compared to the RPS requirement of approximately 3% increase by year 2009, it is not surprising that Texas has achieved a high success.

Texas vs. Arizona

According to the RPS Metric System, the policy in Texas have achieved a High success, and in Arizona a High Medium success. When comparing the design of RPS in Texas with the design of RPS in Arizona it is evident that both states have a positive TS, but there are three important differences in the design of the policy:

1. Cost cap on funding of the policy through. The RPS in Texas does not have any cost caps, but the policy in Arizona provides a cost cap for that. This is a very important issue, which was also mentioned in the ACC Staff Report (2005) as one of the main causes of limited success of policy in Arizona.

2. Import requirements. Arizona allows only import of electricity generated from solar energy, which does not allow other renewable energy sources to constitute fully to the RPS goal.

3. Penalties. RPS in Texas has penalties provided fro non-compliance with the requirements, whereas Arizona does not have any penalties provided. This makes the policy less stronger as it lacks the enforcement tool that ensures the compliance with the requirements.

Texas vs. Hawaii

According to the proposed RPS Metric System, the RPS in Hawaii achieved a Low Medium success. As it is evident from Table 10.1 the TS in Hawaii was negative, which initially limits the success of the policy. But besides the low target setting, the policy in Hawaii also differs from Texas by its design features:

1. Requirement type. The RPS in Texas has mandatory requirements, whereas in Hawaii the policy requirements are voluntary, which significantly affects the chances fro successful implementation of the policy.

2. Funding. The RPS in Texas provides funding through the electricity rates, whereas the RPS in Hawaii does not have any funding provided for the implementation of the policy. This difference is explained by the fact that the electricity market in Texas is deregulated, allowing for market to set the prices for electricity, whereas in Hawaii the electricity system is regulated, and the rates for electricity are fixed.

3. REC trading. The RPS in Texas allows creation and trading of RECs. The policy in Hawaii does not allow REC trading, as a result of regulated electricity system, and also geographic characteristics of the state (remoteness of islands, etc.).

4. Green Pricing. The green pricing can constitute to the RPS requirement in Texas. In Hawaii it is not allowed to constitute to the RPS requirements, thus reducing the flexibility of the compliance with the requirements.

5. Import. The import of renewable energy is not allowed in Hawaii which may limit the RPS success by decreasing the flexibility of the policy. But in case of Hawaii the import of electric energy is not possible due to the geographic characteristics of the state.

6. Penalties. The RPS in Hawaii does not provide penalties for non-compliance with the policy requirements, thus making the policy less stronger as a result of missing the enforcement tool, that ensures the compliance with the requirements.

Texas vs. Maine

According to the RPS Metric System the RPS in Maine have achieved a Low Medium success. As it is evident from Table 10.1 the TS in Maine was negative, initially limiting the success of the policy. In addition to the low target setting, the policy in Maine also differs from Texas by its design features:

1. REC Trading. The RPS in Maine does not allow REC trading, which significantly affects the flexibility of the policy, thus limiting the possibilities for the affected utilities to comply with the policy requirements.

2. Green Pricing. The policy in Maine does not allow the Green Pricing to constitute towards the requirements imposed on electric utilities.

3. Penalties. The RPS I Maine does not provide any penalties for non-compliance with the requirements. This limits the success of the policy as a result of absence of the main enforcement tool.

Texas vs. Wisconsin

As it is evident from the table 10.1, the design of RPS in Wisconsin is identical to the design of the policy in Texas. Nevertheless the RPS in Wisconsin is considered a Low Medium success according to the RPS Metric System due to the low Target Setting. The low TS did not foster development of renewable energy in Wisconsin, moreover renewable energy in the electricity portfolio of the state has significantly decreased (43.43%) since the enactment of the policy (EIA, 2005).

From the conducted cross-case analysis of the RPS design and implementation in the five case-states it is possible to propose that for a successful implementation of an RPS it is necessary for its design to include the following components:

- The RPS requirements should be mandatory
- Target Setting should be positive
- Inclusion of the hydroelectric power in the list of eligible renewable sources should be done taking into consideration the share of the hydropower in the total amount of electricity produced from renewable sources, in a way to secure the development of electricity generation from other renewable

sources, and also avoiding a full reliance on hydroelectric in order to comply with the RPS requirements

- Funding should be provided for compliance with the requirements
- REC trading system should be established, in order to make the compliance with the requirements more flexible and achievable
- Green Pricing should be counted towards the RPS requirements
- There should be no cost cap established for the implementation of RPS funding through the electricity rates
- Import of electricity generated from eligible renewable sources should be allowed
- There should be penalties provided for non-compliance with the RPS requirements.

Table 10.2 represents the comparison of the NY RPS to the RPS design proposed to achieve a success based on the analysis.

Table 10.2 Comparison of the NY RPS to the proposed design

	Recommended RPS design	New York RPS
Requirement type	mandatory	mandatory
Target Setting	TS>0	TS=4.5%
Eligible resources	Hydro should be regulated	Main Tier: Wind, solar photovoltaic, ocean thermal, tidal or wave energy, hydroelectric (less than 30 MW), biogas, liquid biofuel, biomass, fuel cells. Customer-Sited Tier: fuel cells, solar photovoltaic, wind energy (less than 300 kW)
Funding	Through rates	Through rates
REC trading	Yes	No
Green Pricing	Yes	Only the 25th %
Cost cap	No	No
Import	Yes	Yes
Penalties	Yes	No

Table 10.2 shows that there are some differences between the RPS design in NY and the design that according to conducted analysis leads to successful implementation of the policy:

1. The RPS in New York does not allow trading of renewable energy credits between the utilities that are subject to the requirements. This is a result of the uniqueness of the RPS design in New York which represents a centrally administered procurement model. The absence of REC Trading may negatively affect the implementation of the policy by providing no flexibility for the electric utilities to comply with the RPS requirements. According to the RPS Order (NY PSC, 2004) the possibility of REC Trading should be evaluated in 2009 by NYSERDA.

2. The RPS in New York allows only 1% of its 25% requirement to be sourced from Green Pricing programs. Green Pricing programs constitute to a projected voluntary 1% growth in renewable energy generation by the year 2013. Electricity sales from Green Pricing program can not be used to make up for the mandatory 24% requirement during the RPS implementation. This is not a very critical component of the RPS design, and will not affect the implementation of the policy.

3. The RPS in New York does not provide penalties for non-compliance with the policy requirements. The conducted analysis showed that the penalties are a critical component of a RPS policy. The provision of penalties ensures that the electric utilities will comply with the RPS requirements, as a result of higher costs associated with non-compliance. The centrally administered incentive-based mechanism of RPS in New York makes the penalty provision unnecessary, as the required entities should participate in a bidding process in order to get the funds collected through the electricity rates and administered by NYSERDA to finance the renewable energy generation projects.

Based on the conducted analysis of RPS design and implementation in the case-states it is possible to propose the following recommendations that would increase the chances of successful implementation of the policy in New York and in other states:

- ✓ Penalties should be provided for non-compliance with the requirements of the policy. This measure will increase the rate of compliance with the RPS requirements.

- ✓ A system of REC trading should be established that would add a certain flexibility to the implementation of the policy.
- ✓ It is necessary to consider possibilities of counting Green Pricing programs towards the RPS target. Counting of Green Pricing programs towards the RPS requirements should not interfere with the original idea of the policy – voluntary purchase of renewable energy by the end-users of electricity.

References

American Wind Energy Association 2002. *Wind Energy Tax Credit Extended for Two Year.* Retrieved September 2004 from http://www.awea.org/news/news020308ptc.html.

Arizona Corporation Commission, February 2001. *R14-2-1618. Environmental Portfolio Standard*. Retrieved November 5, 2004 from http://www.cc.state.az.us/utility/electric/R14-2-1618.htm

Arizona Corporation Commission, Utilities Division, 2005. *Staff Report on Proposed Changes to the Environmental Portfolio Standards Rule*. Received by e-mail from Ray Williamson, C.E.M., Utilities Engineer, Arizona Corporate Commission.

Berry T. and Jaccard, M., 2001. *The Renewable Portfolio Standard: Design Considerations and an Implementation Survey*. *Energy Policy*, 29(4): 263-277. Retrieved June 5, 2004 from http://www.emrg.sfu.ca/articles/RPSsurvey.pdf.

Chupka M. W., *Designing Effective Renewable Markets*. The Electricity Journal16 (4), 2003. Retrieved September 12, 2004 from www.sciencedirect.com.

Database of State Incentives for Renewable Energy (DSIRE), 2004. *Wisconsin Incentives for Renewable Energy: Renewable Portfolio Standard*. Retrieved December 23, 2004 from http://www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=WI

Electric Reliability Council of Texas, 2003. *2002 Annual Report on the Texas Renewable Energy Credit Trading Program.* Retrieved March 04, 2005, from www.texasrenewables.com/publicReports/2002_Report.doc

Energy Information Administration, Department of Energy, 2004. *Electricity Generation by State and Source Type 1990-2003*. Retrieved March 12, 2005 from http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html

Energy Information Administration, Department of Energy, 2004. *Existing Capacity by State and Source Type 1990-2003.* Retrieved March 12, 2005 from http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html

EPS Cost Evaluation Working Group, *Costs, Benefits, and Impacts of the Arizona Environmental Portfolio Standard.* Arizona Corporation Commission, June 30, 2003. Retrieved January 08, from http://www.cc.state.az.us/utility/electric/costevalrpt.pdf

Espey S., *Renewables portfolio standard: a means for trade with electricity from renewable energy sources?* Energy Policy 29, 2001. Retrieved August 12, 2004 from www.sciencedirect.com.

House of Representatives, Twenty-first Legislature, State of Hawaii, 2001. *Act 272: Renewable Portfolio Standard*. Retrieved March 12, 2005, from http://www.capitol.hawaii.gov/session2001/bills/HB173_cd1_.htm

Langniss O., Wiser R., *The renewable portfolio standard in Texas: an early assessment,* Energy Policy 31, 2003. Retrieved July 07, 2004 from www.sciencedirect.com.

Maine Public Utilities Commission, 2002. *2002 Annual Report on Electric Restructuring*, Retrieved March 12, 2005, from www.state.me.us

Maine Public Utilities Commission, 2003. *2003 Annual Report on Electric Restructuring*, Retrieved March 12, 2005, from www.state.me.us

Maine Public Utilities Commission, 2004. *2004 Annual Report on Electric Restructuring*, Retrieved March 12, 2005, from www.state.me.us

Maine Public Utilities Commission, 2005. *Review of Emerging Technologies As Eligible Resources Under State's Portfolio Requirement*, Retrieved April 5, 2005, from http://www.state.me.us/mpuc/staying_informed/legislative/2005legislation/emerging_tech_rpt.htm

Petersik T., *State Renewable Energy Requirements and Goals: Status Through 2003 (Table 1)*. Energy Information Administration. Retrieved June 12, 2004 from http://www.eia.doe.gov/oiaf/analysispaper/rps/index.html

Public Utility Commission of Texas, 1999. *Substantive Rule 25.173(g): Goal for Renewable Energy*. Retrieved September 13, 2004, from http://www.puc.state.tx.us/rules/subrules/electric/25.173/28407pub.pdf

Rader N. A and Norgaard R.B., *Efficiency and Sustainability in Restructured Electricity Markets: The Renewables Portfolio standard.* The Electricity Journal 9 (6), 1996. Retrieved September 10, 2004 from www.sciencedirect.com.

Rader N.A. and Short W.P., *Competitive Retail Markets: Tenuous Ground for Renewable Energy.* The Electricity Journal 11(3), 1998. Retrieved June 18, 2004 from www.sciencedirect.com.

Rader N.A., *The Hazards of Implementing Renewable Portfolio Standard*. Energy & Environment 11 (4), 2000. Retrieved March 20, 2004 from https://ill.rit.edu/ILLiad/illiad.dll.

Rader N. A. and Hempling S., *The Renewables Portfolio Standard: A Practical Guide*. Retrieved September 10, 2004 from http://www.naruc.org/displayindustryarticle.cfm?articlenbr=15688

Renewable Energy Policy Project, July 2003. *Case Study: Arizona*. Retrieved November 14 from http://www.repp.org/articles/static/1/binaries/Arizona%20Case%20Study.pdf

Renewable Energy Policy Project, July 2004. *RPS Arizona*. Retrieved December 1, 2004 from http://solstice.crest.org/articles/static/1/Arizona_RPS.html

Renewable Energy Policy Project, 2004. *RPS Maine*, Retrieved March 12, 2005, from http://www.repp.org/articles/static/1/Maine_RPS.html

Renewable Energy Policy Project, 2004. *RPS Texas*. Retrieved September 22, 2004, from http://www.repp.org/articles/static/1/Texas_RPS.html

Renewable Energy Policy Project, November 25, 2003. *RP*S Wisconsin. Retrieved December 1, 2004 from http://solstice.crest.org/articles/static/1/Wisconsin_RPS.html

Roschelle A. and Steinhurst W., *Best Practices in Procurement of Default electric Service: A Portfolio Management Approach.* The Electricity Journal 17 (8), 2004. Retrieved September 12, 2004 from www.sciencedirect.com.

RPS Survey, 2005. Williamson R. T. Utilities Engineer, Arizona Corporate Commission.

RPS Survey, 2005. Steven C. Alber, Energy Planner, State of Hawaii, Strategic Industries Division of Department of Business, Economic Development, and Tourism

RPS survey, 2005. M. Tannenbaum, Deputy General Counsel, Maine Public Utilities Commission.

RPS Survey, 2005. E. S. Schubert, Senior Market Economist, Public Utility Commission of Texas.

RPS Survey, 2005. P. Helgeson, Coordinator of Renewable Energy Projects, Senior Engineer, Public Service Commission of Wisconsin

State of Hawaii, 2005. *Hawaii's Renewable Portfolio Standard Law*. Retrieved March 12, 2005 from http://www.hawaii.gov/dbedt/ert/rps.html

State of New York, 2002. *NY State Energy Plan, 2002*. Retrieved on April 4, 2004 from http://www.nyserda.org/Energy_Information/energy_state_plan.asp

Tellis W., *Application of a Case Study Methodology, Winston Tellis*. The Qualitative Report, vol. 3, №3, (1997). Retrieved April 8, 2004 from http://www.nova.edu/ssss/QR/Qr3-3/tellis2.html

Texas State Energy Conservation Office. *Texas' Renewable Energy Resources*. Retrieved March 08, 2005 from http://www.infinitepower.org/reswind.htm

The Senate, Twenty-second Legislature, State of Hawaii, 2004. *Act 95: Related to Renewable Energy*. Retrieved March 12, 2005, from http://www.capitol.hawaii.gov/session2004/bills/SB2474_hd2_.htm

Union of Concerned Scientists, 2004. *State Minimum Renewable Electricity Requirements (as of July 2004).* Retrieved August 12, 2004 from www.ucusa.org/energy

Williamson R.T. and Wenger H.J., *Solar Portfolio Standard Analysis*. American Solar Energy Society's Solar Conference, June 1998. Retrieved on January 10, 2005 from http://www.millionsolarroofs.org/articles/static/1/binaries/Solar_Portfolio_Standard_Analysis_Arizona.pdf

Wisconsin Public Service Commission, April 2001. *Wisconsin Administrative Code, Chapter PSC 118: Renewable Resource Credit Trading Program.* Retrieved January 4, 2005 from http://www.legis.state.wi.us/rsb/code/psc/psc118.pdf

Wisconsin Division of Energy, Department of Administration. *2004 Wisconsin Energy Statistics Highlights.* Retrieved February 27, 2005 from

http://www.doa.state.wi.us/pagesubtext_detail.asp?linksubcatid=601&linkcatid=109&linkid=7

Wiser R. and Langniss O., *The Renewable Portfolio Standard in Texas: an early assessment*. Lawrence Berkeley National Laboratory, 2003. Retrieved June 18, 2004, from http://eetd.lbl.gov/ea/EMS/reports/49107.pdf

Wiser R., Pickle S., Goldman C., *Renewable energy policy and electricity restructuring: a California case study*. Energy Policy 26 (6), 1998. Retrieved August 20, 2004 from www.sciencedirect.com.

Yin R. K., *Case Study Research*, Applied Social Research Methods Series, Volume 5, 1994, SAGE Publications