RENEWABLE PORTFOLIO STANDARD

REPORT

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EXECUTIVE SUMMARY

This report addresses the feasibility of implementing a Renewable Portfolio Standard ("RPS") in Maryland, including the feasibility and structure of a two-tiered RPS, and the costs and benefits of implementing such a standard.[1] An RPS would require sellers of electricity within Maryland to either: (1) generate a specified portion of electricity from renewable resources; or (2) purchase for resale a sufficient amount of electricity generated from renewable resources to satisfy the RPS requirement. A possible third option is to purchase tradable renewables energy credits to satisfy any RPS requirement.

Nine other states have implemented RPS programs.[2] The nature of these programs varies widely with respect to:

- which technologies are considered "renewable";
- what percentage of electricity sold must be generated from renewable energy sources;
- what the initial year percentage renewables requirement is and the speed with which the initial requirement ramps up to the maximum requirement;
- whether the RPS includes sunset provisions;
- whether the RPS includes a cost cap to limit customers' cost exposure as a result of RPS implementation;
- whether mechanisms are included to limit the degree to which existing renewable electric generating facilities can be relied upon to satisfy the standard;
- whether the RPS is structured to ensure that a specified portion of the standard is met from particular technologies;

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[1] This report was prepared to comply with the requirements of Public Utility Companies Article, § 7-516(c)m *Md. Ann. Code* (1999), which requires the Public Service Commission ("Commission" or "PSC"), in consultation with MEA, to report to the Governor and the General Assembly on the feasibility of requiring a renewable portfolio standard in Maryland.

[2] The nine states discussed in the report include Arizona, Connecticut, Maine, Massachusetts, Nevada, New Jersey, Pennsylvania, Texas and Wisconsin. Eight of the nine states have implemented RPSs on a statewide basis. Pennsylvania's RPS arrangements are on a utility-by-utility basis. Since the drafting of the within Report, several changes have occurred. First, Arizona has cancelled its planned RPS and Minnesota and Iowa have since implemented RPS's. Moreover, the information gathered and utilized herein are for demonstrative purposes only.

- whether the program includes establishment of a market for tradeable renewable energy credits;
- what specifications apply to generating facility siting requirements;
- whether the RPS goes beyond renewables generation requirements and includes other environmentally preferable approaches, such as demand-side management and energy conservation;
- what the methods are for administration of the program; and
- whether there should be establishment of penalties for non-compliance.

It is clear from the language of Public Utility Companies Article Section 7-516 that the General Assembly was concerned about the potential impact of electric restructuring on the natural environment of Maryland. Several approaches can be utilized to address this concern. Among them are emissions caps, such as those in the Clean Air Act Amendments, tax incentives to encourage cleaner conventional-fueled generation, and policies that promote a greater percentage of generation from renewable resources known to be less harmful to the environment. Section 7-516(c) specifically requires the Commission to address the feasibility of promoting renewable resources using an RPS.

The purpose of implementing an RPS is to permit renewable technologies to overcome the perceived barriers and market imperfections that have heretofore impeded effective competition with conventional (fossil fuel) technologies. The RPS approach is seen as a way to allow renewable technologies to capture the advantages of scale economies (which will reduce costs and make these technologies more competitive) and also to provide the market with a base of experience with renewable energy technologies. The increased reliance on renewable technologies to satisfy electric power requirements that will result from an RPS could provide a broad range of benefits, including reductions in the emission of certain pollutants, increases in fuel diversity, and economic and employment benefits to the State.

The principal emissions anticipated to be reduced with the implementation of an RPS include CO_2, NO_X, SO_X, and CO. Benefits associated with fuel diversity, such as, increased price stability and insulation from potential disruptions in supply, have been identified but may not be substantial. The economic and employment benefits related to RPS implementation are difficult to quantify. However, such benefits to Maryland will also accrue to other states in the region as they share in any economic and employment benefits resulting from a Maryland RPS.

Because the cost of generating power using renewable energy sources is higher than the cost of generation using conventional technologies, implementation of an RPS is likely to increase costs to end-users of electricity in the State. Estimated costs range from between 0.09¢/kWh to 0.21¢/kWh averaged over the 2002 - 2015 period. This range of costs suggests an average per-household cost impact to residential customers in Maryland of between $9.70 and $22.70 annually. This is based on average monthly energy use of 900 kWh. The cost impact for a large commercial customer, e.g., a hospital, with a peak demand of 5,000 kW is estimated to be between $30,000 and $70,000 per year. The cost impact varies according to a variety of factors, including the percentage of renewables required, whether sunset provisions are included, and which technologies are identified as renewable.

Other factors expected to affect RPS costs are whether existing renewables generating facilities are excluded from the RPS, whether the RPS includes an effective cost cap, and whether in-State siting requirements are imposed. In general, the more restrictive the requirements, the greater the cost impacts. For example, a two-tiered RPS, which sets aside a particular portion of the RPS requirement to be met from specific technologies such as solar or wind, would be more costly than a single-tiered RPS because satisfying the two-tiered requirement would require suppliers to use higher cost technologies. The standard under a single-tiered arrangement could fully be met from the least-costly renewable energy sources.

Other programs have been implemented or are under consideration in other states to promote electric generation from renewable or environmentally preferable energy sources. These programs include:

- "green power" marketing, whereby sellers of electric power can offer power generated using renewable or other environmentally preferable energy sources. End-users typically pay a premium above the cost of power generated from conventional sources;
- government purchases of "green power" to satisfy all or a portion of the government's electric energy requirements;
- tax incentives for businesses and individuals to invest in renewables technologies;
- grants to support research and development in renewables technologies; and
- "systems benefits charges" which are collected from end-users of electricity through a surcharge, and are used to support renewables generation, low-income energy assistance, energy conservation and demand-side management.

An RPS for Maryland is feasible, whether it is structured as a single-tiered program or as a multi-tiered program. This is supported by the enactment of RPS programs in other states. Alternatively, an assessment could be made of whether other environmental programs could be implemented in lieu of an RPS that will substantially meet the RPS policy goals alone or be implemented in conjunction with an RPS to more effectively attain the articulated policy targets.

In investigating this matter, Commission Staff consulted and collaborated with the Maryland Energy Administration ("MEA"), the Maryland Department of Natural Resources ("DNR"), and the Maryland Department of Environment ("MDE"). Staff circulated its RPS report to all parties of record and interested parties on January 6, 2000. Staff's report was also circulated to members of the Power Plant Research Advisory Committee for comment as to its technical accuracy. MEA, the Office of People's Counsel ("OPC"), the Joint Utilities,[3] the Maryland Public Interest Research Group-Maryland League of Conservation Voters - Sierra Club Maryland Chapter (referred to herein as "the environmental collaborative"), Remote Power Group, LLC ("RPG"), Curtis Engine & Equipment, Inc. ("CEEI"), BRESCO (a waste-to-energy proponent), and the Mid-Atlantic Power Supply Association ("MAPSA") filed comments on Staff's report. This report considers the comments and suggestions made by the above referenced parties, and a cost – benefit analysis prepared by the Union of Concerned Scientists ("UCS").

Additionally, since the report was prepared, the proposed Eastern Correctional Institute's cogeneration biomass project and Conectiv's Vienna station project have been rejected. However, two new projects, (1) Fibrowatt – a 40 MW facility in Dorchester County and (2) an Allen Family Foods – 4 MW project in Hurlock have added to the list of planned renewable projects in Maryland.

[3] The Joint Utilities include Allegheny Energy, Inc., Baltimore Gas & Electric Company ("BGE"), and Potomac Electric Power Company (Pepco).

I. INTRODUCTION

Pursuant to § 7-516(c) of the Public Utility Company Article ("PUC"), the Commission, in consultation with the MEA is required to report to the Governor and to the General Assembly on the feasibility of an RPS, the structure of a two-tiered RPS and the estimated costs and benefits of establishing such a requirement.[4] Section 7-516(c) is part of the Electric Customer Choice and Competition Act of 1999 ("the Act"), enacted in April 1999. The purpose of the Act is to:

> (1) establish customer choice of electricity supply and electricity supply services; (2) create competitive retail electricity supply and electricity supply services markets; (3) deregulate the generation, supply, and pricing of electricity; (4) provide economic benefits for all customer classes; and (5) ensure compliance with federal and State environmental standards.[5]

As a result of the Act and the Commission's many initiatives in Case No. 8738, restructuring of the electricity services industry in Maryland is well underway.

In Maryland, as well as other jurisdictions, questions have been raised concerning the impact of electric utility restructuring on the environment. The production of electricity has associated environmental and economic impacts -- regardless of the source --whether by conventional or renewable generation. In an effort to balance the goals of electric restructuring, i.e., provide economic benefits for all customer classes, and promote energy efficiency and renewable energy resources, some states have introduced and implemented renewable portfolio standards.

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[4] *Md. Ann. Code,* PUC § 7-516(c) provides that " . . . the Commission, in consultation with the Maryland Energy Administration, shall report to the Governor and, subject to Section 2-1246 of the State Government Article, to the General Assembly on the feasibility of requiring a renewables portfolio standard, including the feasibility and structure of a two-tiered standard, and the estimated costs and benefits of establishing this requirement."
[5] Section 7-504.

Other options for achieving these important goals currently exist, or can be implemented. Policies such as emissions caps (Clean Air Act Amendments) and tax incentives (or disincentives) that promote cleaner generation, can provide economic benefits, protect the environment and support the development of renewable resources by making more damaging resources less attractive. An RPS is only one mechanism available to policymakers for achieving a balance of energy efficiency, economic benefits, and protection for the environment.

An RPS requires sellers of electricity within the State (or within the region) to either: (1) generate from renewable resources a specified proportion of the electricity sold to end-users; (2) purchase for resale a sufficient amount of electricity generated from renewable sources to satisfy the renewables requirement; or, as a possible option (3) purchase tradeable renewable energy credits in sufficient quantity to satisfy the standard.

An RPS is a mechanism for directly ensuring development of renewable energy (such as wind, solar, biomass, geothermal, hydroelectric, tidal or waste-to-energy) in an implementing jurisdiction, region or state. The research and information gathered by the Commission's Staff indicates that: an RPS for Maryland is feasible; a two-tiered RPS structure would cost more than a single-tiered structure in Maryland; an RPS would reduce Carbon Dioxide (CO_2), sulfur oxides (SO_X), nitrogen oxides (NO_X) and Carbon Monoxide (CO) emissions. The costs of an RPS would increase residential electric rates on average between \$9.70 and \$22.70 per year.

A. Background and Method of Study

In addition to its background information and rationale, this report incorporates an analysis performed by the Union of Concerned Scientists ("UCS") that evaluates the cost and benefits of implementing various scenarios of an RPS for Maryland.[6] The Appendices provide an overview of renewable energy technologies, how they work, and their commercial viability in Maryland along with other background information. The cost-benefit analysis contained in this report was prepared by the UCS using parameters defined by the Staff, MEA, DNR-PPRP and MDE. No alternative methodologies or analysis was offered by any of the commenters.

1. Renewable Energy Defined

The term renewable energy can refer to a broad range of resources. In general, renewable energy can be characterized by its sustainability, by its relatively few environmental impacts, and by its minimal risks to human health as compared to conventional or non-renewable resources. The Act lists a number of renewable energy resources to be considered for Maryland, including solar photovoltaics; solar thermal; wind; tidal; geothermal; biomass; waste-to-energy; landfill gas; digester gas; and hydroelectric facilities. A full description of each of these resources, including costs and technical feasibility, is included in Appendix A.

The purpose of an RPS is to improve environmental quality, and to promote and develop renewable technologies. Ideally, market forces operate to produce a price for a good or service that reflects the marginal social cost of its production. It has been argued that significant costs associated with the production of electricity are not reflected in the direct price that a consumer is charged. These costs, known as negative externalities, can include such things as air and water pollution and the associated health risks to humans.

[6] The Union of Concerned Scientists is an independent nonprofit organization that conducts technical studies and public education.

An RPS should consider the broad range of environmental effects from energy production, and should represent an effort to protect society's long-term stake in environmental quality. To avoid or mitigate some of the environmental impacts associated with electric utility restructuring, a number of states have adopted various strategies which include an RPS. Additionally, several of the restructuring bills now before the Congress include one or more of these strategies.

2. Structure of a Two-Tiered Standard

Section 7-516(c) requires that the feasibility and structure of a two-tiered RPS be addressed. A two-tier standard creates different percentages of the total portfolio, both of which a supplier must fulfill. A two-tier approach is used to segment certain resources that currently exist within the State or need no encouragement, from other technologies that currently may not be competitive with other renewable resources. Generally, states have used existing technologies to comprise the first tier and have created a second tier to encourage development of more costly technologies that have the potential to be price competitive in the future.

3. Current Status of Renewable Energy in Maryland

Table I-1 in Appendix D provides a summary of renewable energy projects that provided capacity and energy to Maryland electric customers in 1998. Net capacity refers to the capacity that is available during system peak periods. Net generation is the electricity that is dispatched to the grid after the electricity that is used to run the facility is subtracted from total generation. The term "qualifying facility" or "QF" refers to whether a project qualifies for the incentives provided by the Public Utility Regulatory Policies Act ("PURPA") and meets standards established by the Federal Energy

Regulatory Commission (“FERC”).

In calendar year 2000, Maryland renewable energy projects are expected to yield 372 MW. This represents approximately 2.8 percent of the total capacity allocated to Maryland customers. If hydroelectric resources are excluded, renewable energy capacity equals approximately 0.7 percent of the capacity allocated to Maryland customers in calendar year 2000.[7] On a national level, the total capacity associated with renewable energy projects is 12.2%. The difference between Maryland and the nation is due in part to the large hydro resources found in other states compared to Maryland’s smaller hydro resources. Approximately 2 percent of the total energy generated for Maryland customers in 1998 was generated from renewable resources. Renewable energy resources, excluding hydroelectric power, accounted for 0.7 percent of the energy generated. This estimate is based on resources that are owned by Maryland utilities or under contract to Maryland utilities. On a national level, the total energy generated by renewable resources equaled 11% for all resources (including hydro) and 2% for renewable resources excluding hydro.

II. RATIONALES FOR RENEWABLE PORTFOLIO STANDARD

A. Environmental Impacts Typically Associated with Conventional (Non-Renewable) Generation

Electricity generation, regardless of the source of generation, affects the environment. In recognition of this fact, generation resources are comprehensibly regulated under the Clean Air Act, which is enforced by the Environmental Protection Agency ("EPA"). Proponents of renewable energy frequently note that, compared to

[7] *See* Table I-2 in Appendix D attached hereto.

conventional resources, renewable energy resources have relatively few environmental impacts.

Coal-fired generation is the single largest source of SO_x emissions, which are the main cause of acid rain. SO_x emissions combine with moisture in the atmosphere, increasing its acidity. This moisture then falls to the earth in the form of precipitation. The result is that the chemistry of lakes and rivers is altered to such an extent that it can become too acidic for plant and animal life. Acid rain can also damage crops and buildings. National reductions in SO_x emissions are required by the Clean Air Act. In the year 2000, SO_x limits will be tightened when Phase II of the Clean Air Act begins.

Burning fossil fuels also emits NO_x into the air, which combines with other chemicals in the atmosphere to form ground-level ozone in the presence of sunlight. Both NO_x and ozone (O_3) can irritate the lungs, cause bronchitis and pneumonia, and decrease resistance to respiratory infections. The EPA has published a new rule reducing NO_x emissions from 0.12 parts per million to 0.08 parts per million. States have until 2003 to submit plans for meeting the new standard and up to 12 years to achieve this standard.

While the Clean Air Act has resulted in reductions of SOx and NOx, there are plants that have been exempt from complying with these regulations due to their age. Plants that were operating when emission limits were adopted were not held to the same stringent standards as new plants. If competition leads to downward pressure on prices and increased demand for electricity, some believe that many of these older units, which have relatively low production cost, could be used to generate more electricity. The Clean Air Act does not regulate many other pollutants such as carbon dioxide, mercury and lead emissions.

In addition to NOx and SOx emissions, electricity generation using fossil fuels also results in emissions of CO_2. Carbon dioxide is the most important of the greenhouse gases, which contribute to global warming by trapping heat in the earth's atmosphere. In 1997, at a conference in Kyoto, Japan, the developed nations of the world agreed to reduce CO_2 emissions. The U.S. agreed to 7% reductions from 1990 levels by the period 2008-2012. The U.S. Senate has not ratified this treaty.

In addition to emissions of SO_x, CO_2 and NO_x, the burning of fossil fuels to generate electricity produces a number of other air pollutants. These include carbon monoxide (CO), fine particulates and large particulates. Large particulates can cause headaches and place additional stress on people with heart disease or respiratory problems. Large particles (10 microns in diameter) are regulated by the Clean Air Act.

In 1997, the EPA published a new rule limiting emissions of fine particles (2.5 microns). States have until 2005 to 2008 to submit plans to the EPA for meeting this standard and another 12 years to comply. There are also other emissions resulting from fossil fuel use that include heavy metals such as lead and mercury.

In addition to air pollution, the use of fossil fuels has significant impacts on water and land quality. Land and water damage can occur throughout the life cycle of fossil fuels, from mining, drilling, refining, to shipping, use, and disposal. Among the impacts typically cited are oil spills, coal mining waste, and air emissions settling out on land and water. For example, coal-mining practices can contribute to land and water pollution. During the mining process toxic chemicals brought to the surface can leach into water supplies.

Although nuclear power plants do not have the same level of air emissions associated with fossil fuel plants, they create other environmental problems related to waste disposal. Waste from nuclear plants that require disposal, include spent fuel rods (high level waste) that are currently being stored at power plant sites. High level waste can remain radioactive for several hundred years. To date, the U.S. Department of Energy has not completed a permanent storage facility, slated to be developed at Yucca Mountain, Nevada, to entomb these rods which will remain radioactive.

B. Benefits of Renewables

1. Environmental

All sources of electricity generation produce some form of negative environmental impacts, including renewable energy resources. However, proponents of renewable energy maintain that renewable energy can have substantially fewer negative environmental impacts. Probably the single most important benefit that has been attributed to renewable energy generation is that it typically has fewer air emissions than conventional resources. In general, renewable energy resources emit less $SO_{2,}$ $NO_{x,}$ CO_2 and fewer particulates than coal, oil, or natural gas for the same energy output. Additionally, renewables may have fewer land and water impacts than conventional resources.

2. Economic and Employment Development Benefits

Proponents of renewable energy technologies have noted that renewable energy can have positive effects on local and regional employment and economic development. Employment benefits may result from the fact that certain renewable technologies are more labor intensive than conventional technologies. The development of the renewables industry can result in an increase in the production of new and existing renewable technologies. Some studies have been performed that support this assertion. For example, Maryland is home to Solarex Corp, a firm that develops and manufactures photovoltaic cells. Increases in sales or research and development could have potential economic benefits through expansion of their facilities or start-up of new manufacturing facilities.

In California, a measurable economic benefit has resulted from the implementation of a systems benefits fund which takes into account renewable energy subsidies. The California Energy Commission estimates that 600 MW of new renewables will be built using $162 million in public benefits funding in the state restructuring law. It is estimated that such efforts will induce $700 million in private capital investment, 10,000 construction jobs (with over $400 million in wages), 900 ongoing operations and maintenance jobs (with $30 million in long-term salaries), gross state product impacts of $1.5 billion during construction, and $130 million in annual ongoing operations. In addition to creating jobs, renewables can improve the economic competitiveness of a region by enabling it to avoid additional costly environmental controls on other industries, as well as by stabilizing long-term energy prices.

Estimating the economic and employment benefits that an RPS could bring to Maryland is a very complex endeavor. Questions need to be answered about a state standard versus a regional standard and the percentage of renewables required. These options are discussed in Section III. The level of any benefits would be directly related to the structure of the RPS. Additionally, an RPS may not be the only way to achieve these benefits. Indeed, other policies could potentially be more cost-effective.

3. Diversity and Energy Security Benefits

Renewables could offer added economic stability to the mix of U.S. generation technologies. Some analysts have argued that depending on only a few energy resources makes the country vulnerable to volatile prices and interruptions to the fuel supply. Natural gas is generally considered the fuel of choice for new power generation because it is cleaner than coal, and capital costs for power plant construction are lower. However, excessive reliance on natural gas could also create problems. Natural gas and fuel oil usage compete with each other in some applications. Fuel oil in the past has been susceptible to supply shortages and price spikes. Since most renewables do not depend on fuel markets, they are not subject to the same price fluctuations resulting from increased demand, decreased supply, or manipulation of the market. Further, since fuel supplies are local, renewable resources are not subject to control or supply interruptions from outside the region or country.

C. Barriers to Renewables Technologies

The term “barriers” as used herein refers to market imperfections, institutional factors, and government polices that may preclude the frictionless entry of a new product, process, or firm into an existing market. This section identifies the barriers facing renewables technologies and how an RPS can be used to counterbalance at least some of these barriers. The implementation of an RPS can be designed to reduce the impacts of entry barriers that may affect renewables technologies. Absent the existence of significant barriers, reliance on an RPS to foster the development of the market for renewables technologies would be unnecessary since these technologies would be able to compete with conventional electricity generation technologies on an equal footing in the free market. Some of the issues addressed herein are not barriers *per se,* but rather factors that typically face new industries, such as infrastructure development and achieving economies of scale.

The following barriers to renewables technology market penetration are addressed below:

- Lack of scale economies;
- "Level playing field" issues resulting from unequal tax treatment;
- Externalities associated with fossil fuel generation;
- High transaction and financing costs; and
- Imperfect information.

Evidence suggests that renewable energy technologies are not produced in sufficient volume to capture the full benefits of scale economies. Increased production is hampered by the high cost of energy generated using renewables technologies relative to conventional technologies. Consequently, the scale economies issue is seen as being a circular problem.

It is noted that the degree to which future costs can be reduced as a result of scale economies is unclear. The market for at least certain types of renewable energy technologies is likely to be sufficiently large to accommodate several plants of minimum efficient size. If multiple plants currently operate at or below minimum efficient size, competitive opportunities exist for a firm to construct and operate a larger plant, produce at lower cost, and capture a sufficiently large share of the market. However, other barriers, as discussed below, may hamper market incentives.

Renewables have relatively low fuel and operating expenses compared to conventional fossil fuel plants and larger capital investment requirements on a per-kWh basis. Some analysts argue that because fuel and operating costs are deductible from taxable income, the tax burden on generators using renewable technologies is greater. These analysts also argue that because certain renewables technologies (e.g., wind, solar) entail significant land requirements, generators relying on renewable energy technologies will be subject to higher property taxes per unit of energy produced. A 1996 study indicates that the total tax burden for natural gas facilities averages approximately $0.51 per kWh compared to $1.52 for biomass generators. [8] Other studies have also documented higher tax burdens for generators of electricity relying on renewable energy resources.[9]

Fossil fuel prices reflect the benefits of the depletion allowance, which allows companies to deduct the reduced value of reserves due to resource extraction, and exploration and development costs that can be expensed rather than capitalized and depreciated.

It should be noted, however, that some of these perceived inequities have been addressed on the federal level. Federal tax incentives for renewables technologies have been permitted that fossil fuel plants do not enjoy. For example, federal tax credits are permitted for electricity generated wind and closed-loop biomass.

Fossil fuel generation entails adverse environmental impacts, which affect society as a whole. Because fossil fuel generators are not charged for these impacts, it is argued that the total societal cost for power generated using fossil fuels is greater than the market price, with the differential representing what is in essence a subsidy to fossil fuel generators.[7]

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[8] Dallas Burrow, *Renewable Energy Tax Issues*, Resources for the Future, prepared for the U.S. Department of Energy, Office of Utility Technologies Analysis Workshop, July 23, 1996 as cited in Alan Node *et al*., *Powerful Solutions -- 7 Ways to Switch America to Renewable Electricity*, Union of Concerned Scientists, January 1999, p. 17.

[9] Stanton Haley, Lawrence Hill, and Robert Precook, *Report on the Study on the Tax and Rate Treatment of Renewable Energy Projects*, Oak Ridge National Laboratory, ORNL-6772, December 1993; Alec F. Jenkins, Richard A. Chapman, and Hugh E. Really, *Tax Barriers to Four Renewable Electric Generation Technologies*. Both references cited in Node *et al*., p. 18.

[7]Alan Node et al., *Powerful Solutions*, p. 28.

Generation from renewables technologies entails less adverse environmental impact than does fossil fuel generation. No mechanism, however, is in place to bridge the price gap between fossil fuel generation and renewables generation related to the imposition of societal costs from fossil fuel generation. Consequently, it is argued that there is sub-optimal generation from renewable energy sources and more-than-optimal levels of generation from fossil fuel generating facilities.

In a competitive electric supply market, consumers of electricity may lack the necessary information on which to base purchasing choices regarding electricity generated from renewable energy resources. For example, electric generation using renewable energy resources may be perceived as unreliable since solar technologies can only be used when sunlight is available, and wind technologies can only generate power when wind conditions are favorable. Additionally, consumers may not be well informed about the environmental impacts associated with non-fossil fuel as well as fossil fuel generation, which could result in skewed purchasing decisions.

Generating projects relying on renewable energy sources tend to be substantially smaller than fossil fuel generating projects. Consequently, transaction costs, a portion of which are relatively invariant with respect to project size, are higher on a per-kWh basis for renewables projects than for the larger fossil fuel projects. Examples of such transaction costs include costs associated with obtaining financing, contract negotiation costs, and licensing and permitting costs.

Financing costs for renewables projects may be higher than for fossil fuel generating projects because of the smaller size of renewables projects relative to fossil fuel projects, and because renewables projects tend to be viewed as entailing greater risk to the lending institution. This problem is exacerbated by the generally higher initial capital investment required by renewables projects (on a per-kWh basis) and the long capital recovery period associated with electric generation facilities.

The implementation of an RPS is anticipated to relieve or nullify many of the barriers noted above. By requiring a specific proportion of all electricity sold in the state to be generated from renewable energy sources, the following effects on barriers would be expected:

- Scale economies -- A Maryland-only RPS would have a marginal impact on the ability of manufacturers of renewables generating and related equipment to achieve the cost reductions associated with economies of scale. A regional RPS would be expected to have a proportionally larger impact.

- Externalities -- An RPS would not materially affect this barrier for the portion of the market that is not set aside for electricity generated from renewable energy sources.

- Imperfect information -- The implementation of an RPS may serve to disseminate information regarding renewables generation to consumers and could favorably affect the market position of renewables generation.

- Transaction costs -- The problems associated with high transaction costs on a unit-of-energy basis that affect renewables generation are not anticipated to be affected by an RPS for other than the set-aside levels.

- Financing costs -- Financing costs for renewables projects may be favorably affected by an RPS through reduced perceptions of riskiness on the part of lending institutions and increased familiarity with renewables projects. These influences could be anticipated to affect the market as a whole.

In general, an RPS is a "command and control" policy. Suppliers are required to buy a specified percentage of their power from renewable resources. An RPS does not fundamentally alter the incentives or disincentives associated with renewable resources.

D. RPS Activity in Other States

Nine states have adopted renewable portfolio standards. [11] Additionally, there have been a number of electric utility restructuring bills that have been introduced into the U.S. Congress that include provisions for renewable portfolio standards.

Other states have considered the implementation of RPS policies as part of the restructuring legislation processes that are still pending.

1. Maine

To date, Maine has enacted the highest level of RPS in the nation. The standard in Maine requires that at least 30% of the electric providers supply source be from renewable energy starting in 2000.[12] Every retail supplier must demonstrate that a minimum percentage of retail electricity sales is generated from renewable resources.

While the Maine standard may appear to be very high compared to other states, it is important to note that renewable resources account for approximately 50% of Maine's electricity mix. The different fuel sources permitted in the RPS are tidal, solar, wind, geothermal, hydro, biomass, Municipal Solid Waste (MSW) under 100 MW and qualified small power generation facilities. The legislation includes a provision requiring the commission to review the RPS in five years and recommend any changes to it. The provision does not include a credit trading system.

2. New Jersey

New Jersey requires that all suppliers of electric power sell 2.5% of renewable energy to customers.[13] The 2.5% is calculated on an energy basis (kWh) sold in the state.

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[11] Table II-1 provides a summary of the RPS by state.
[12] Maine Revised Statutes Annotated. Title 35-A. Chapter 32-10.
[13] New Jersey Board of Public Utilities. Draft Interim Renewable Portfolio Standards.

The sources of energy allowed are classified in two categories, Class I includes solar technologies (photovoltaics and solar thermal), wind, fuel cells, geothermal, wave, thermal, methane gas, and sustainable biomass. Class II includes hydroelectric facilities that are located where retail competition is permitted and also provides that the State's Commission of Environmental Protection has determined that the facility meets the highest environmental standards. The interim standard has determined that only hydroelectric facilities of 30 MW or less qualify as a Class II renewable energy source.

The New Jersey bill requires that one half of one percent (0.5%) of each kilowatt-hour sold in the state by each electric provider be from Class I resources in 2001. In addition, the legislation requires an increase of 1% by January 2006, with an increase of the required percentage by 0.5% each year until 2012. Under this scenario, the percentage of Class I renewable resources sold in the state by the year 2012 will be 4%. The 2.5 percentage from Class II remains constant until 2012. In the year 2012, 6.5% of the energy sold in the state will be from Class I and Class II resources. It is estimated that the RPS policy will result in an increase in the installed capacity of Class I technologies of 497 MW by 2010.

Every supplier is required to document compliance with the minimum percentage of renewables in an annual report filed with the Board of Public Utilities. The report must include the total amount of kilowatt hours sold to New Jersey retail customers during the preceding year and the percentage of total output generated from Class I and II sources to retail customers.

3. Massachusetts

The legislation approved in 1997 requires all suppliers of electric power to provide at least 1% of energy sales to end-use customers from new renewable energy source by 2000. The level increases to 4% in 2009.[14] The sources of energy include, solar, wind, ocean thermal, wave or tidal, fuel cells, landfill gas, waste to energy, and hydro. From these sources, advanced biomass, and waste to energy cannot count towards the new standard. The RPS is a regional standard; thus energy generated outside the state can be used to satisfy the Massachusetts' requirements. The Department may consider including existing renewable sources to meet the RPS.

4. Connecticut

Another state that passed an RPS in restructuring legislation is Connecticut.[15] The required percentage of renewable supplies specify a two-tier standard program that accounts for 5.5% renewables in 2000, 6% in 2005 and 7% by 2009 and thereafter on an energy basis. The percentage of required renewables is based on total capacity provided for every retail supplier in the state. Also, the standard is based on a regional approach where out of state capacity is eligible to meet the target. The eligible sources of capacity are classified as Class I and Class II. The Class I eligible resources include solar power, wind power, fuel cells, methane gas, landfill gas or biomass facilities where the fuel source is harvested in a sustainable manner. Class II eligible resources are defined as the capacity from trash-to-energy facilities, or biomass that does not meet the criteria for Class I, or hydropower facility.

The implementation of the RPS policy will increase new capacity of Class I

[14] Massachusetts, Chapter 164 of the Acts of 1997. House Bill No 5117.

resources about 31 MW in 2000, increasing to 164 MW in 2005 and increasing to 412 MW in 2010. The total capacity including Class I and Class II in 2000 accounts for 346 MW, 395 MW in 2005 and 481 MW in 2010.

The Connecticut legislation allows the electric suppliers to satisfy the requirements of the RPS by participating in a renewable trading program approved by the state. At this time no credit mechanisms have been developed. As part of the compliance verification, the licensing projections require that, not later than October 1 of each year suppliers must submit to the Commission documentation demonstrating that the supplier complied with the RPS in the previous 12 months based on capacity information from the Independent System Operator.

5. Arizona

Arizona rulemaking established that renewable energy resources comprise 0.2% of the energy mix of suppliers in 1999. The state requires that renewables energy usage rise to 1% in 2003. The standard applies to electricity generated from photovoltaic and solar thermal projects installed after January 1, 1999.[16] The standard would also reserve 20% of RPS levels for other renewables, most likely to be landfill methane.

6. Nevada

Legislation enacted in Nevada requires a level of 0.2% renewable energy consumption as of January 2001, which increases 0.2% biannually until it reaches 1% in 2009.[17] The sources of energy needed to comply with this standard should be 50% from new solar or solar thermal that commenced operations after July 1, 1997. The other 50% must be from geothermal, wind and biomass fuels that are naturally generated.

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[15] Connecticut, HB No. 5005. Public Act No. 98-28.
[16] Arizona, AAC R14-2-1601 *et. seq.* SPS (R14-2-1609)

7. Texas

The legislation in Texas enacted an RPS based on total installed capacity (existing and new capacity).[18] The existing renewable resources are 880 MW. The standard requires that new and existing renewables increase to 1280 MW by 2003, and would ramp up to 2880 MW by 2009. The sources permitted to meet the target are solar, wind, geothermal, hydro, wave, tidal, biomass, and biomass-based waste products, including landfill gas. The provision also includes a credit trading market, penalties, credit banking and early start by the year 2002.

8. Wisconsin

The state of Wisconsin was the first to adopt an RPS without retail competition. The percentage required is 0.5% in the year 2001, increasing to 2.2% by the year 2011. 0.6% of the RPS can come from renewable energy facilities installed before 1998. The eligible technologies included in the RPS are wind, solar, biomass, geothermal, tidal, and a fuel cell that uses a renewable fuel. It has also included hydro facilities under 60 MW.[19]

9. Pennsylvania

Pennsylvania has not adopted a statewide RPS. However, an RPS component was adopted for the traditional electric utilities. The requirement imposed on the utilities is on a service territory basis. For Philadelphia Electric Company (PECO), West Penn Power (West Penn), and Pennsylvania Power and Light Company (PP&L) in 2001, 2% of 20% of the residential customers will be provided energy from renewable sources increasing 0.5% every year. For General Public Utilities (GPU), it is required that 0.2% of 20% of all or residential customers will be provided from renewable sources,

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[17] AB 366. Section 52.
[18] Senate Bill 7.

increasing to 0.2% of 80% of all or residential customers by 2004. The RPS is not required for all suppliers in the state, nor was the policy enacted as part of the restructuring legislation. The Sustainable Energy Fund ("Fund") was approved in the state as part of the settlements reached with the utilities pursuant to the stranded cost cases.

The Commission also created a State board to provide additional oversight, guidance and technical assistance to the regional board(s). The regional and the statewide board will work to ensure that the Fund promotes a consistent plan that leverages investments in new technology. The regional board, in conjunction with the statewide board must identify potential opportunities, prioritize the Fund's objectives and develop an outreach plan to garner further support for these initiatives. The statewide board will be integrated with diverse expertise to guarantee that adequate assistance is provided.

The Pennsylvania Public Service Commission approved the joint petitions for full settlement with the four major utilities. The settlement requires each company to establish a Sustainable Energy Fund to promote the development and use of renewable energy and clean energy technologies, conservation, efficiency and renewable business initiatives.

10. Other States

Other states, such as New Mexico, Kansas, Nebraska, Iowa, Vermont, and Minnesota have considered an RPS. In Kansas and Nebraska, the restructuring legislation that includes an RPS policy is pending.

The legislation in Vermont is still pending, however the draft proposal includes provisions of the RPS with which suppliers may have to comply. It includes a two-part

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[19] Reliability 2000, included in the state budget.

portfolio approach applicable to all electric utilities. The first part requires that a percentage of each utility's sales in the state be generated from Tier 1 renewable resources. The second part requires that an additional percentage be generated from a second tier of renewables. The required level of renewable resources for part one is required to be at least equal to the proportion of the retail electric consumption, and associated transmission and distribution losses, in 1995. The required level for part two should increase each year and be equal to 4% in the year 2007.

Further the Vermont legislation provides a tradable energy credits system. The sources of energy permitted for the RPS include wind, solar, and biomass (other than municipal solid waste). The acceptable technologies for generating the RPS energy include solar-thermal, photovoltaics, fuel cells, biomass gasification, and biomass combustion. Currently the state derives 15% of the electric generation from renewable sources.

New Mexico's legislation proposes that suppliers offer renewable energy but does not define a specific RPS. Instead, all suppliers applying for a license are required to submit a proposal for a renewable energy supply service option to the customers. In addition, the New Mexico legislation directs the public service commission to further examine the advisability and desirability of requiring a RPS in supply service offered to the customers in the state.

The state of Iowa does not define an RPS, instead, the Alternate Energy Production Law, revised in 1991, enacted a minimum requirement for renewable energy based on capacity for investor-owned utilities that state. The eligible technologies include solar, wind, methane recovery and biomass. The initial standard was 150 MW of renewables for the state on a capacity-basis. Today installed capacity from renewables totals 250 MW in Iowa, most of which is wind powered.

The Minnesota legislature enacted a set aside program that requires Northern States Power (NSP) to build or contract out for 225 MW of wind power by December 31, 1998. NSP must build or contract out an additional 200 MW by December 31, 2002. In addition, NSP was required to build or purchase 50 MW of electric energy from farm grown, closed-loop biomass systems by December 31, 1998 and an additional 75 MW must be built or purchased by December 31, 2002.[20]

D. Congressional Initiatives

There have been a number of bills introduced during the 105th and 106th Congresses that include provisions for a national RPS. These provisions were typically included as part of proposals for electric industry restructuring. Most recently five bills have been introduced in the 106th Congress that include provisions for a national RPS. These proposals have been introduced by Representatives Edward J. Markey (R-MA) and Steve Largent (R-OK) (HR 2050), Senator James Jeffords (R-VT) (S. 1369), Representative Frank Pallone (R-NJ) (HR 2569), Representative Dennis Kucinich (R-OH) (HR 2645), and the Clinton Administration (S. 1048) (HR 1828).[21]

1. Markey - Largent Bill (HR 2050)

The RPS included in the Markey - Largent proposal establishes a level of 3% renewable energy generation in the year 2005, if DOE's Energy Information Administration ("EIA") determines that the energy generated from renewables is less than this level in 2004. The RPS required by this legislative proposal is applicable to all

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[20] Stat. 216B.2423. Minnesota PUC Order Docket E-002/RP-98-32
[21] *See* Table II-2 in Appendix D attached hereto.

retail suppliers and is proposed to end in 2015. The renewable resources allowed to meet this target should be from wind, solar, biomass, and geothermal. While the RPS creates a renewable energy credit trading program, the bill does not address any provisions regarding emissions standards.

2. Kucinich Bill (HR 2645)

The proposal calls for a 2% RPS in 2000, increasing to 0.5% from 2000 to 2004. After 2004, the percentage of increase every year will be 1% until it reaches 15% in 2015. The proposed eligible technologies will be biomass (not MSW), landfill gas, geothermal, solar and wind. A credit trading system is allowed in this proposal. The proposal provides a cap for emissions of SO_X, CO_2, NO_X, mercury and nuclear waste.

3. Pallone Bill (HR 2569)

On July 20, 1999, Representative Pallone (D-NJ), introduced the Fair Energy Competition Act of 1999. This proposal contains a strong environmental and customer protection policy. It also includes a Public Benefit Fund, net metering provision, and disclosure of information requirement. In addition, the proposed bill provides an emissions cap for mercury and a trade mechanism for SO_x, CO_2, NO_x. Moreover, the bill includes a RPS mandating that sellers use 7.5% from non-hydro renewable resources on an energy basis.

4. Clinton Administration Bills (S. 1048) (HR 1828)

A proposal offered by the Clinton Administration in 1999 would require an increase to the amount of renewable energy to 7.5% of total generation in 2010. From 2000 to 2004, this bill would adopt levels set by the DOE and the RPS would be administered by the DOE. DOE will determine the annual transition target from 2005 through 2009. The standard would apply to all retail electric suppliers. The resources allowed in this provision are wind, solar, biomass, and geothermal. The program also creates a credit system and allows for credit banking. The provision includes a NOx allowance and a trading program. It specifies a System Benefits Fund program and also intends to cap the NOx emissions according to the EPA administered NOx trading program in accordance with National Ambient Air Quality Standards for Ozone.

5. Jeffords Bill (S. 1369)

On July 14, 1999 Senator Jeffords introduced a bill that would make certain amendments to the Clean Energy Act of 1999. Included in this proposed legislation are provisions for an RPS of 10% by 2010 increasing to 20% in 2020. In addition, the proposal establishes a Public Benefits Fund to preserve state programs for renewable energy. The proposal also includes net energy metering to protect the rights of customers who produce their own renewable energy to connect to the electric grid and get credits for the excess of energy they contribute.

6. RPS Proposals Introduced During the 105th Congress

The impacts of the RPS policies were analyzed by five different entities: Union of Concerned Scientists (UCS), DOE, EIA, the Tellus Institute of Boston and Energy Innovations. All of these studies used either the National Energy Modeling System (NEMS) or RenewMarket.[22] The differences between these two models are the assumptions adopted with respect to fossil-fuel price projections, technology costs, financing costs, technology learning curves, renewable resource costs and supply constraints.[23]

[22] RenewMarket is also the model used by the UCS in Section V of this report.
[23] The results of the different studies reflect the costs and benefits of the RPS in comparison with a system

III. IMPLEMENTATION ISSUES

The purpose of this section is to demonstrate the myriad of options available in developing an RPS and provide information about the development of a legal and administrative framework that would be required to administer the program.

A. Definition of Renewables

Table III-1 summarizes how various states define renewable energy. There is a great deal of variation among the states. For example, for purposes of its RPS, Arizona includes only solar thermal and photovoltaics. In contrast, Maine's RPS includes all of the resources except methane and photovoltaics. Maryland, as set forth in the Act in § 7-516, has the most comprehensive procedure for dealing with the issue of renewable energy.

B. Single vs. Multi-tiered Approaches

Maryland's statute outlines renewable energy resources, which are similar to the definitions of renewable resources adopted by states across the country. Within this definition, a single standard approach can be adopted. A single standard approach essentially treats all renewable energy resources as equals and allows the market to determine the contribution various renewable resources will make toward the fulfillment of the standard. Suppliers can meet the RPS by purchasing/or producing energy from any resource defined as renewable. This approach creates incentives for suppliers to procure the lowest cost electricity produced from a renewable resource, thus minimizing the cost of the RPS that is passed on to consumers.

with no RPS as shown in Table II-4.

A multi-tiered standard approach differentiates among renewable resources for the purpose of promoting greater diversity in suppliers' portfolios. Essentially, this approach creates two or more portfolios that suppliers must fulfill. The multi-tiered approach that has been adopted in New Jersey classifies renewable resources into one of two categories. The Class I category includes photovoltaics, wind, fuel cells, geothermal technologies, wave or tidal action, methane gas from landfills, and certain biomass applications. Class II includes resource recovery facilities or hydroelectric facilities, provided that such facilities are located in areas where retail competition is permitted and meet community and environmental standards prescribed by the Commission of Environmental Protection. Similarly, Connecticut has adopted a two-tiered standard for electric generation capacity.[24]

A two-tiered standard seeks to balance the goals of minimizing the cost of the RPS with encouraging new technologies. It does so by creating a standard for suppliers to use existing renewable resources, usually hydroelectric resources. Typically, these resources represent economic resources since they have been competing with existing conventional resources. It also creates set asides for newer, sometimes, less mature technologies. This creates a guaranteed market and allows for growth in the newer technology if the policy calls for a ramping-up of the standard over time. Initially, this approach can have higher costs since the tier provides a market share for less developed technologies. It can be argued that as markets develop for these technologies, costs will decline to a point where they are competitive with conventional resources.

[24] Table III-1 provides a summary of the two-tiered systems in New Jersey and Connecticut. There are no published studies in New Jersey or Connecticut regarding the costs and benefits of this option.

D. Appropriate RPS Level

A critical issue concerning the implementation of an RPS concerns the appropriate level of renewables. This issue has two components: 1) the technical reasonableness, and 2) the establishment of deadlines for compliance. How this issue is addressed will have an important impact on the level of benefits that can be achieved and the cost to consumers.

A review of the states that have implemented a renewables portfolio standard indicates that there is a great deal of variation as to the level of renewables prescribed by the standards. For example, Maine has a prescribed standard of 30% of retail access sales. In contrast, the Public Utilities Board in New Jersey has adopted an interim standard of 2.5%.[25] It appears that the levels adopted in each state are largely determined by the existing levels of renewable energy and the resource base. Maine, for instance, has substantial existing hydroelectric resources that do not exist in New Jersey.

In establishing the standard, consideration should be given to technical reasonableness. This issue concerns an analysis of forecasted production costs, manufacturing capacity and market development. In this case, the issue is whether the industry can deliver the product at the projected prices. There are technical considerations described above, but also market constraints as well. If, for example, several states simultaneously adopt similar standards for a particular technology, the increase in the quantities demanded could potentially create shortages and higher prices. For example, Arizona will require 250 MW of solar resources to fulfill the RPS at an estimated cost of $500 million by 2003. Arizona Public Service Company, the state's largest electric utility, estimates that it is cheaper to pay the 30 cents per kWh penalty for noncompliance than to meet the standard.[26] Clearly, a standard is not reasonable or meaningful if the renewables industry cannot deliver the product or if one has to overpay for electricity produced due to supply constraints.

Another issue concerns the establishment of deadlines for attainment of standards. This could involve setting the initial target for implementation, intermediate targets and dates for meeting these targets, and a date for reviewing the standard. Finally, some states have included sunset provisions (a specific date when the RPS will end). These factors have important implications for the cost of the program. These issues will be further addressed in the analysis section.

E. Product vs. Company Standard

A critical issue concerning implementation is whether the RPS should be applied to a supplier or whether it should be product based. In a deregulated generation market, it is expected that suppliers may offer a number of different supply options. A company - based RPS would allow a company to comply with an RPS if the sum of all of its products met the prescribed standard. That is, a supplier could offer lower cost products that did not include any renewables, while other products, such as a "Green Power"[27] product, could contain all renewables. The alternative is a product-based approach, which requires that all products contain the minimum level of renewables specified by the RPS.

Connecticut has adopted a company-based standard, while Maine recently changed from a company-based to a product-based standard. The company-based

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[25] Arizona, Nevada and Wisconsin have all adopted intial standards of less than 1%.
[26] Prevost, Lisa. "Renewable Energy: Toward a Portfolio Standard," *Public Utilities Fortnightly* (Vol. 136, No. 15), August 1998, p. 36.
[27] Green Power is defined as electricity that is generated from renewable energy sources.

standard allows a company to market both green and completely non-green products. A major concern with the company-based approach is equity. The additional costs of the RPS are not distributed across all customers. Instead, the costs are focused on customers who choose to purchase green products. A concern with the product-based approach is that it could make green marketing more difficult. Some customers who might otherwise be willing to purchase green power could recognize that all products contain some sources of renewable energy by law and, therefore, decline to purchase a separately marketed green product. It appears that half of the states have not yet addressed this issue and the remaining half are split between the two approaches.[28]

F. New vs. Existing Renewables

Another issue to be addressed is whether inclusion of existing resources in an RPS fosters new resource development or simply results in an economic rent accruing to the owners of the existing resources. The decision regarding inclusion or exclusion of existing resources has important implications for total program costs and policy goals and will affect the decision regarding the timing and size of the standard.

As discussed earlier, total Maryland renewable energy projects are expected to amount to 372 MW in calendar year 2000. This represents approximately 3% of the total capacity allocated to Maryland customers. If hydroelectric resources are excluded, renewable energy capacity equals approximately 0.7% of the capacity allocated to Maryland customers in 2000. On an energy basis, of the total energy generated for Maryland customers in 1998, approximately 2% was generated from renewable resources. Renewable energy resources, excluding hydroelectric power, accounted for

[28] Arizona - company-based (green pricing programs qualify); Maine – product based; Massachusetts – not yet defined; Connecticut – company based; Nevada – not yet defined; New Jersey – not yet defined.

0.7% of the energy generated in 1998. This estimate is based on resources that are owned by Maryland utilities or under contract to Maryland utilities.

G. Credit Trading and Verification Options

States with an RPS have used various methods for implementing the program, including credit trading. Under a credit trading program, the electric suppliers will be able to meet the required percentage of renewables under an RPS by generating, or purchasing electricity generated from renewable resources or by buying tradable credits from another supplier. The credits will be created as each unit of electricity is generated from renewable sources. The credits will be sold by the renewable energy generating company to any electric suppliers that need to meet the RPS.

Nevada, for instance, may include the credit for renewable energy resources per kWh of energy produced, and the holders of credits may sell or trade the credits with other parties. Verification is conducted by the electric utilities, and alternative sellers must submit an annual report to the Commission that provides information of compliance with the RPS requirement. If the utility installed a renewable energy system during the period, the report should contain the date of installation, capacity, production, portion that is derived from renewable energy, and the quantity of renewable energy that is transmitted or distributed.

Maine does not include any provision for RPS that allows the suppliers to participate in a credit trading system. For verification purposes, suppliers are required to provide, over a 12 month period, a general description of how the RPS requirement will be met at licensing. The suppliers must file an annual report by May 1 of each year demonstrating compliance for the previous year. Certified audits may be used as a form of compliance at a later date. The Commission may conduct periodic audits to verify compliance.

The legislation in New Jersey allows the electric power suppliers or basic service providers to satisfy the requirements contained in the RPS by participating in a renewable energy trading program. For verification purposes, the electric power supplier must keep all documentation of renewable energy sources (Class I and Class II) in excess of the portfolio for any given year. The credit trading program was adopted in Texas as well.

Finally, in Massachusetts, the Division of Energy Resources (DOER) will conduct a study to assess awarding credits to renewable generators or retail suppliers. This credit trading program would then require subsequent legislative approval.

H. Regional vs. State Standard

Maryland is currently served by members of PJM, 9 regional power markets and APS. Power sold in Maryland for use by consumers within the State is not necessarily generated in Maryland. Establishment of a Maryland RPS, therefore, could result in regionally generated power from renewables simply being assigned to Maryland, as opposed to being assigned to other states within the region that do not have an RPS in place. Additionally, an RPS implemented in Maryland in isolation could be perceived as placing Maryland businesses at a competitive disadvantage relative to businesses in the same industry in nearby states not having an RPS.

As a practical issue, it may be difficult to coordinate with other states in the regional markets (New Jersey, Pennsylvania, Delaware, and Virginia) to develop a uniform RPS. At a minimum, a regional RPS would take much longer to implement and may be more difficult to administer. It is noted that nine states have already implemented renewables portfolio standards, but none have done so on a regional basis and there have been no initiatives in this regard. All of those that are in place are structured as one-state-only.

Furthermore, to the extent that a Maryland-only RPS is restricted to new renewable resources, the importance of this issue is diminished since, from an environmental perspective, new renewable resources (whether located within or near Maryland) would have benefits accruing to all states in the region.

I. Energy versus Capacity Standard

An RPS can be based on energy generation or installed capacity. An energy-based standard requires that a certain portion of total sales (either product or company-based) be generated from renewable resources. The alternate method is for the standard to be based on installed capacity where a supplier would be required to simply contract with or own a facility that uses renewable resources. With the exception of Texas and Connecticut, all states that have implemented an RPS have done so on an energy basis.

A capacity-based standard could have applicability in Maryland since three of four investor-owned utilities are members of the PJM Independent System Operator (ISO). The ISO requires that all suppliers maintain minimum levels of installed capacity, plus a reserved margin, which is determined by PJM. The result is that an active and competitive market for capacity exists in this region. APS is not a member of PJM and does not have a capacity requirement *per se*. To that extent, the implementation of a capacity-based RPS may be problematic.

J. Program Administration

There are two approaches to program administration. The first is a settlement-based tracking system. This involves using the same system used by the ISO to track and settle transactions throughout the system. An ISO is responsible for the operation of the transmission system, system reliability, the dispatch of plants, and market oversight of transactions. In terms of market oversight, the ISO settlement system determines ownership of energy that is transmitted to consumers. In this region BGE, Pepco, and Conectiv are members of the PJM ISO, which also has members in Pennsylvania, New Jersey, Maryland, Delaware, and Virginia. The major impediments to this approach are concerns regarding whether the ISO has the software capability to track the energy source of transactions to their fuel and whether the ISO is willing to do so for a state. New Jersey is planning to rely on this approach. APS, however, is not a member of PJM, which may be problematic in developing a settlement tracking system.

The second approach to program administration is a credit-based approach. Credits are assigned to all existing renewables among project developers, utilities, and ratepayers. Additionally, credits must be assigned to renewables developed after commencement of the program. An issue exists as to defining the renewables credit trading area (state, region, and national). In contrast to the settlement approach, a credit approach could offer greater flexibility.

For example, to demonstrate the added flexibility, extra credits or multipliers can be assigned to certain technologies or to projects that are located within a region. Arizona has adopted such a system to reward in-state installations and solar systems manufactured within the State. In this respect, the credit system could be used to further certain policy objectives. Additionally, a credit-trading system can be established that allows for credit trading and banking of credits. With this approach, a supplier can either generate credits through the ownership of renewable generation projects or can acquire credits in the market from accredited projects. Credit trading would require the development of a regional tracking and verification system. Using a credit-based system requires that an agency be designated and a process be established for certifying renewable credits.

Regardless of the approach used, it is necessary to designate an agency responsible for verification of resources to prove that suppliers are fulfilling their minimum obligation for renewables.

A method of RPS enforcement is required to ensure compliance and establish penalties for noncompliance. Penalties adopted by other states include suspension and/or revocation of the supplier's license (Connecticut, Nevada, and Maine), monetary fines (Arizona and Maine), and prohibitions from accepting new customers (Connecticut).

K. Cost Cap

The cost of an RPS to Maryland customers can only be estimated based on projections of differential costs of electric power generation from renewable and conventional services. As the percentage of total energy sold in the State that is required to be generated using renewable resources increases, it can be expected that costs may also increase in the short run as the lower cost opportunities become exhausted, other things being equal. Counterbalancing this upward pressure on prices is the expectation that with increasing familiarity with generation using renewable resources, and with the realization of scale economies, the cost of generation from facilities relying on renewable fuels will eventually decline. To the extent that cost reductions are not realized and/or the cost of generating power using renewable resources is underestimated, a cost cap would serve to protect consumers from cost exposure in excess of what was envisioned when the RPS was implemented.[29] A cost cap could, however, result in the diminution of the impact of the RPS on fostering development of renewable technologies and may interject additional uncertainty regarding the ability of renewable technology investors to recover project costs.

L. Sunset Provisions

As noted above, one of the goals of an RPS is to provide a platform for making renewable technologies viable in the market place. The RPSs, in general, that have been enacted to date have been structured to expire after a predetermined period with the assumption that when the RPS expires, the target renewable technologies would be competitive with conventional technologies. The duration of the standard should reflect a sufficient amount of time to permit the target technologies to be viable. However, imposition of such a time period should not be so long that economic distortion results from the availability of excess economic profits accruing to the owners of renewable resource facilities that are fully capable of competing with conventional technologies. Most of the RPSs that have been implemented (or proposed) to date have specified a minimum renewables target to be met in the first year of the program and a higher target to be met by the terminal year of the program. During intervening years, interim requirements ramping up to the terminal year requirement are imposed. This structure provides a stable and continuous market for the target renewable technologies throughout the life of the program, does not overburden the industry responsible for the development of renewable energy facilities, and mitigates cost impacts to consumers of electric power. Implementation of an RPS requires, therefore, that not only must a specified percentage

[29] The method by which a cost cap would operate is discussed in Chapter V.

of electric energy be generated using renewable fuels by the last year of the program, it also needs to specify the interim renewables requirements.

IV. Policy Alternatives

An RPS is one of a number of policies that have been considered by states as part of the restructuring process. A number of states have elected not to adopt an RPS. Instead, they favor other mechanisms such as green power, a systems benefits charge, tax policy, emissions caps and government purchases. This section will describe some of these alternatives.

The advantages of an RPS include providing assurance for meeting a defined level of renewables development, creating and protecting the renewable market from competition from nonrenewable resources (e.g. helps facilitate the commercialization of these technologies), and providing some level of certainty in the renewable power industry. Such certainty could help encourage investments in renewable generation projects and lower the cost of capital for these projects. An RPS is also competitively neutral in that all suppliers are required to meet the minimum standards. Further, there is no prohibition against marketers exceeding the standard if consumer demand for renewables exceeds the standard.

There are a number of disadvantages to an RPS. First, a standard as implemented focuses on baseload energy markets, or in certain cases capacity markets. In these markets, energy typically can be produced for $0.035/kWh or less. Capacity is currently valued at approximately $70.00 kW or less. Many newer technologies such as photovoltaics are not competitive in these markets, but are very close to competitive in premium markets such as peak power and reliability. The standards that have been implemented in other states to date do not address these markets. An additional concern is whether the RPS can be implemented by individual states or regions, or whether such implementation would be precluded by either the Commerce Clause of the U.S. Constitution or by FERC preemption. This specifically deals with the location of resources within state boundaries.

A. Green Power

Green pricing is defined as any mechanism whereby electricity customers may voluntarily buy electricity from renewable resources, usually, at a price higher than what the customer would expect to pay for electricity generated from conventional resources. Green power policies allow utilities to offer consumers the option of purchasing renewable energy as part of the consumer's energy mix. Since current renewable energy sources are often more expensive than electricity generated from traditional sources, these "green pricing" programs usually offer consumers the option to pay a little more for clean energy. Green pricing also implies that customers will receive environmental benefits from their purchases.

Surveys have revealed a high degree of customer willingness to pay extra for "green" power. In general, from 40% to 70% of respondents nationwide have expressed willingness to pay premiums of between 6%-10% for "green" products. Surveys show that a percentage of those customers unwilling to pay for green power themselves may prefer providers who have a green portfolio (even if it is paid for by other customers).[30]

Green pricing allows suppliers to encourage renewables development at no competitive cost to themselves or to customers uninterested in renewables. This could

[30] Node, Clemmer, Paulos and Haddad, *Union of Concerned Scientists, Power Solutions*: Seven Ways to Switch America to Renewable Electricity, p. 37 (January 1999).

promote greater development of renewables than would otherwise be cost-effective based on current market prices for fossil fuels and traditional utility economics. This, market-based approach, reduces the onus on suppliers to pursue renewable opportunities that are cost effective on their own merits. Relying solely on the market, may therefore, delay development of new technologies. Environmental benefits may also be delayed or reduced.

B. Systems Benefits Charges

A system benefits charge ("SBC") is a fee placed on customers' electricity bills. Several states have passed electric industry restructuring legislation with an SBC to support renewable energy, energy efficiency, low-income customer programs, or other functions that the competitive market is unlikely to provide on its own. The SBC is designed to be competitively neutral and consequently is usually "non-bypassable." The term non-bypassable means that every customer is subject to the charge. It is also designed not to place the entity charged with collecting the fee at a competitive disadvantage.

"System benefits" have been defined as a class of services that are in the "public interest" or public purpose programs that were sometimes provided by utilities in a regulated environment but may not be provided in a competitive environment. These typically include low-income customer services, conservation investments, renewable energy resource acquisition, and research and development funding. The public benefits that could result from these investments include affordable energy bills, improved health and safety, a cleaner environment, increased reliability, economic development, and reduced fossil fuel price risks.[31]

Several states have implemented non-by-passable SBC to fund such activities as universal service, market transition costs, education universal service, energy efficiency, low-income DSM and renewable energy resources. These charges can be used to help subsidize the costs of renewable portfolio standards.

SBCs vary by state. The Regulatory Assistance Project estimates that the current cost of system benefits ranges from 1%-5% of the average bill. The Project also indicates that these costs are often allocated on a consumption or use basis proportional to kilowatt-hour consumption, kilowatt demand, or both. These charges are also allocated on a per-customer basis or by the customer class that received certain benefits, although these approaches are less common. In California, for example, electricity customers pay $0.003/kWh to support renewable energy and energy efficiency programs. The SBC may also be assessed as a flat fee per customer. In Pennsylvania, electricity customers pay a flat $5 per month to support consumer education programs. The major advantage of a SBC is that funds can be targeted to specific projects within a jurisdiction.

M. Government Purchases

Virtually all of the state government programs addressing renewables relate to building standards that incorporate active or passive solar designs or otherwise attempt to incorporate renewables into building construction. These programs encourage the use of renewable energy equipment and energy efficiency measures in order to produce energy savings over the life of a given building. These programs require the consideration of cost-effectiveness life cycle in building planning. Consequently, they do not have the shortened payback period (sometimes as short as 3-5 years) that are common in the

[31] *Id.* at 28.

private sector. Government purchase programs, however, are not voluntary. The cost of purchasing renewable energy may be significantly higher than from traditional energy sources.[32]

To date, only Pennsylvania has issued a competitive solicitation to procure a portion of the state government's electric energy requirement from generators relying on renewable resources. In January 2000, Pennsylvania awarded a contract to supply approximately 5 percent of the state government's energy requirements using renewable resources. The winning bidder will satisfy the requirement using hydro power. Pennsylvania also established the Governor's Green Government Council to examine alternative approaches.

The only other government entities that have solicited for "green power" apparently have been a U.S. Environmental Protection Agency laboratory in California, the City of Santa Monica, California, and two consortiums of municipal governments -- one comprised of municipalities near San Diego and the other comprised of municipalities near San Francisco.

D. Taxes and other Financial Incentives

A number of states currently provide tax incentives to encourage renewable energy. These programs are designed to encourage investments in renewable energy resources by reducing the initial cost of renewable energy equipment and/or the cost of operating renewable energy projects. The types of tax incentives include sales, property, personal, and corporate.

Table IV-2 summarizes the various tax incentives available in states to promote renewables. Eleven states offer personal tax incentives to promote renewables; 10 offer

[32] *See* Table IV-1 in Appendix D attached hereto.

state sales tax incentives; 18 states provide property tax incentives; and 10 provide state corporate tax incentives. These incentives take the form of tax deductions, tax breaks, and tax credits. The Commission Staff did not identify any studies, which provide an assessment of tax incentives, in terms of total costs and impacts. Other financial incentives include industrial recruitment incentives, special grants, and loan programs to encourage renewable development.[33]

V. COSTS – BENEFITS ANALYSIS

The Union of Concerned Scientists (UCS) estimated the costs and benefits of an RPS in Maryland using a UCS compute model. No other commentor to this report provided any alternative approach to the UCS model.

The UCS analysis addressed the following:

1. The costs and benefits of various renewable standards
2. The potential impacts of sunset provisions
3. The impact of including biomass co-firing in an RPS
4. The impact of the ramp-up periods on costs
5. The costs and benefits associated with a two-tiered RPS

To address these issues, the following hypothetical RPSs were analyzed

Case 1 - 5.5% RPS by 2007, no sunset***, with*** biomass co-firing

Case 2 - 5.5% RPS by 2007, no sunset, ***without*** biomass co-firing

Case 3 – 5.5% RPS by 2007, sunset in 2012, ***with*** biomass co-firing

Case 4 - 5.5.% RPS by 2007, sunset in 2012 ***without*** biomass co-firing

Case 5 - 3.5% RPS by 2005, no sunset, ***with*** biomass co-firing

[33] *See* the following web site for additional information about individual state tax incentives and other financial incentives. http://www-solar.mck.ncsu.edu/finance.htm

Case 6 - 7.5% RPS by 2009, no sunset, ***with*** biomass co-firing

All of the scenarios assume that the RPS targets would ramp-up gradually over time based on a percentage of projected total retail sales in Maryland and that the requirement would be met through credit trading. In each case, the initial target was assumed to be 1% of total retail sales in 2002 and ramp-up at 1% per year and 0.5% in the last year before leveling out at the target and year shown above. Furthermore, it was assumed that only wind, biomass, solar, landfill gas and geothermal energy were eligible to meet the RPS. The Act states hydro and MSW are renewable resources but these were not included in the model.

A. Methodology

To estimate the impacts of the proposals, the UCS utilized an electricity market model they have developed, called RenewMarket, which is patterned after the Electricity Market Module (EMM) of the National Energy Modeling System (NEMS).[34] Like the EMM, the main function of the RenewMarket model is to determine what power plants are likely to be built in 13 reliability regions throughout the U.S., including the Mid-Atlantic Area Council (MAAC) reliability region. This area includes, but is not limited to the PJM region. It does not, however include Allegheny Power.

The RenewMarket model does this by comparing on a regional basis, the long-term costs of competing technologies and assigning the largest market share to the lowest-cost technology, subject to certain constraints. The model considers inputs of costs and performance characteristics of generating technologies and region-specific projections of electricity demand, plant retirements, fossil-fuel prices, renewable resource

[34] A fuller description of the RenewMarket model can be found in Appendix B. NEMS was developed by the Energy Information Administration in the US Department of Energy, and is used to forecast future

potential, and financing costs. RenewMarket uses different projections of renewable technology costs, including biomass with coal in existing coal-steam plants. It also applies different constraints to wind resources, makes different assumptions about the technology learning curve (the tendency of technologies to become less expensive with greater cumulative installed capacity), and draws on a data base of existing plants to estimate annual fuel use and pollutant emissions. The forecast period may extend to 2030.

Currently, the RenewMarket model is only capable of modeling an RPS proposal for an entire region, such as the MAAC region. It is not capable of analyzing state-specific RPSs, unless the state is its own reliability region (which is basically only the case for California, New York, Texas, and Florida). However, due to interstate commerce rules, state-level RPS laws probably cannot require in-state siting of renewable generators, though this has not been challenged yet in the few states that have adopted in-state requirements.[35] Therefore, a regional RPS analysis that allocates a portion of the costs and benefits to Maryland based on its share of the region's generation can serve as a reasonable proxy for estimating the potential impacts of meeting a Maryland-specific RPS.

The six hypothetical scenarios described above were modeled as regional RPSs. This assumes that providers in other states in the region would have to meet the same RPS requirements. To date, New Jersey and Pennsylvania have adopted RPS

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energy use and prices in the US for its publication Annual Energy Outlook.

[35] Texas and Nevada have adopted in-state requirements. This may not be an issue in Texas since the state is it's own reliability region with significant transmission constraints for importing and exporting power. For more information on interstate commerce issues see Kirsten Engle, Tulane Law School, "The Federal Constitution and State Implementation of Renewables Portfolio Standards: An Analysis of Commerce Clause Issues," Memorandum for the American Wind Energy Association, March 13.

requirements that are lower than the scenarios modeled in this analysis. Since less renewables generation would be needed to meet a Maryland-specific RPS than a regional RPS, the cost estimates below should be considered conservative.

B. Assumptions

The most significant assumptions used in the analysis to determine the costs and benefits of achieving the RPS targets are:

- projected fuel prices
- the characteristics of existing and new fossil fuel and renewable power plants
- the regional supply, cost, and quality of renewable resources
- financing costs

There are three major categories of costs that the model considers: 1) new plant construction; 2) plant dispatch: and 3) technology learning curve.

New Plant Construction. In determining which plants to build in a given region and year, RenewMarket seeks to minimize the present value of long-term plant capital and operating costs.

Plant Dispatch. The aim of the plant dispatch module is to minimize current total operating costs while satisfying electricity demand. To do this, RenewMarket first ranks the available plants in order of increasing variable operating costs (including both fuel and variable operations and maintenance costs). Second, it dispatches each plant in rank order until it meets the expected demand in each load period.[36]

Technology Learning. RenewMarket assumes that the costs of advanced fossil-

[36] Renew Market uses an eleven-step load duration curve to simulate plant dispatch based on data from EIA that is used in the EMM.

fuel and renewable technologies decline over time as a result of growth in the domestic and international market, and research and development.

RenewMarket models the RPS by progressively lowering the operating costs of qualifying renewable plant types until the RPS target is met. The amount by which the cost must be reduced is called the shadow price. By applying the same shadow price to all qualifying units—and allowing the model to choose the mix of units to be added to minimize the current value of long-term costs—this approach ensures that the RPS target is met at the lowest cost under the assumptions and within the limitations of the model.

The shadow price works in two ways. First and most importantly, it lowers the annualized (or levelized) cost of new renewable units that are competing to be built. Second, it lowers the operating costs of both new and existing renewable plants in the dispatch module. In both cases, the shadow price is applied only when needed to boost renewable energy generation to the level required by the targets.

The shadow price calculated by the model directly measures the amount of economic stimulus required to achieve the RPS target. Thus, it should relate in some fashion to the price renewable credits it would command in a credit market. However, the shadow price (as used in the build decision) is a levelized quantity that applies over the lifetime of units built in a particular year, whereas the credit-trading price should equal the value that the market places on the last kilowatt-hour of renewable generation required to meet the target in a single year. The relationship of two quantities depends on characteristics of the market which are difficult to predict.

Consider the perspective of a generator interested in building a renewable plant. Suppose that RenewMarket accurately estimates the shadow price the plant owner would require to justify going forward. At what actual price would the generator have to sell its renewable credits in its first year of operation? The answer depends on the plant owner's expectations of income from future credit sales, as well as the owner's perceptions of the risks to that future income stream. The problem is similar to that encountered in the stock market, where buyers and sellers set the current price of stock on the basis of expectations of the stock's future price and earnings.

The issue is further complicated by the fact that markets for renewable credit futures and options could arise, or renewable plant owners could enter long-term contracts with electricity providers to sell their credits on a fixed price schedule. In addition, power companies might choose to spread their own costs of meeting RPS targets over a number of years to reduce the customer impact. All of these factors could affect how much consumers ultimately pay for the RPS and when they pay it.

To address this challenge, the model assumes that the credit-trading price in any given year equals *either* the current value of the levelized credit in that year minus the current value of expected income from future credit sales, *or* the shadow price, whichever is larger. The first term occurs when the credit price is falling, the second when it is rising. By starting at the end of the study period (when the shadow price is assumed to reach some constant value) and working backward, we are able to calculate a stream of credit prices that will provide the economic stimulus required by the model. (See Appendix for more details on how credit prices are calculated).

Results

Case 1 - 5.5% RPS by 2007, no sunset provision with biomass co-firing included

Under this run, the 30-year levelized incremental cost of meeting the renewables targets steadily rises to a peak of $0.023/kWh in 2005, when the RPS target reaches 4%, and then steadily declines to $0.009/kWh in 2009 and $0.004/kWh in 2015. As discussed above, UCS' method for calculating the credit price assumes that renewable developers will attempt to recover more of their above market costs in current years when the credit price is higher. They also assume that retail suppliers will spread their costs over a 7-year period to reduce the volatility in credit prices to consumers in any given year. This explains why the credit price rises from $0.003/kWh in 2003 to a peak of $0.042 c/kWh in 2009 and then steadily falls to $0.01/kWh by 2020.

The credit prices translate into an average rate impact of $0.00095/kWh (or 0.95 mills/kWh) between 2002 and 2030, assuming the above market costs of renewables are spread across all projected retail sales. This is equivalent to a $0.47 per month (1.1%) increase in the electricity bill of a typical (500 kWh/month non-electric heating) household than without the RPS.

In the first few years, retail suppliers would meet the vast majority of their requirement with existing biomass and landfill methane generation available in the region as well as new biomass co-firing at existing coal plants. Biomass co-firing is estimated to rise to 827 MW by 2006. This reduces the region's coal generation compared to the base case. New wind generation also starts to contribute in a significant way by 2004 and steadily increases to 2,100 MW by 2015, with its market share of total non-hydro renewable generation increasing to 41%. New wind generation largely offsets new natural gas generation, however, gas generation is still projected to more than quadruple by 2014 even with the RPS.

As new renewables offset both existing coal and new gas generation, regional CO_2 emissions decline by 6 million metric tons by 2010 compared to no RPS. This is equivalent to CO_2 savings of 1.4 million metric tons for Maryland, based on their current share of the region's electricity sales.

The results also show an increase in CO_2 emissions in 2003 under the RPS.[37] This occurs because biomass co-firing changes the dispatch order in the model in that year compared to the base case, in favor of existing coal generation and new natural gas combustion turbines over new natural gas combined cycle units. This is likely due to model limitations in how biomass co-firing is analyzed and how new plant construction decisions are made relative to how existing units are dispatched. Regardless, the increase in CO_2 emissions is made up in less than 3 years as additional biomass co-firing capacity displaces existing coal generation and as new wind generation displaces new natural gas generation. CO_2 savings continue to grow to a peak of 8.6 million metric tons in 2014.

The results also indicate coal and gas generation fluctuating up and down between 2012 and 2015. This occurs because the variable operating costs of existing coal plants and new gas plants are very close in those years. The model uses a set of standard unit types to characterize existing power plants in the region, which can result in large blocks of certain unit types to be displaced when average costs are slightly higher or lower than competing units in a given year. In reality, existing power plants of certain types have a range of costs and operating conditions. While this situation is not very realistic, it should not significantly affect the projected costs of meeting the RPS, though it does have some impact on projected CO_2 savings.

Case 2 - 5.5% RPS by 2007, no sunset provision, without biomass co-firing

The results of this scenario show that without biomass co-firing, the cost of the RPS would increase across the board compared to Case 1. This is because more expensive generation from biomass gasification power plants and additional wind capacity are needed to meet the renewables targets. However, even with these higher costs, the average rate impact is only 1.34 mills/kWh or $0.67/month (1.6%) more on a typical household's electric bill. Also, CO_2 emissions savings are relatively similar to Case 1, indicating that biomass gasification, operating under baseload conditions, does displace some existing coal generation.

Case 3 - 5.5% RPS by 2007, sunset in 2012, with biomass co-firing

The main difference between Case 3 and Case 1 is that the costs to consumers are considerably higher between 2010 and 2017 because of the sunset provision. After 2012, there is no guarantee that renewable developers will receive any additional income above the wholesale market price of power. This has the effect of temporarily raising the costs to consumers between 2010 and 2017, as shown in Exhibit V-1, as retail providers spread their above market costs over a 7-year period to help reduce the price volatility. However, the costs to consumers falls to zero by 2018 when retail suppliers have recovered all of the above market costs.

The results also show that with the sunset, renewable generation drops from 5.5% of total sales in 2011, to 3.8% in 2012, and to 3.2% in 2020. This is because an ongoing credit is needed to keep certain renewable units (mainly some higher cost biomass and landfill gas) running that have slightly higher operating costs than conventional units.

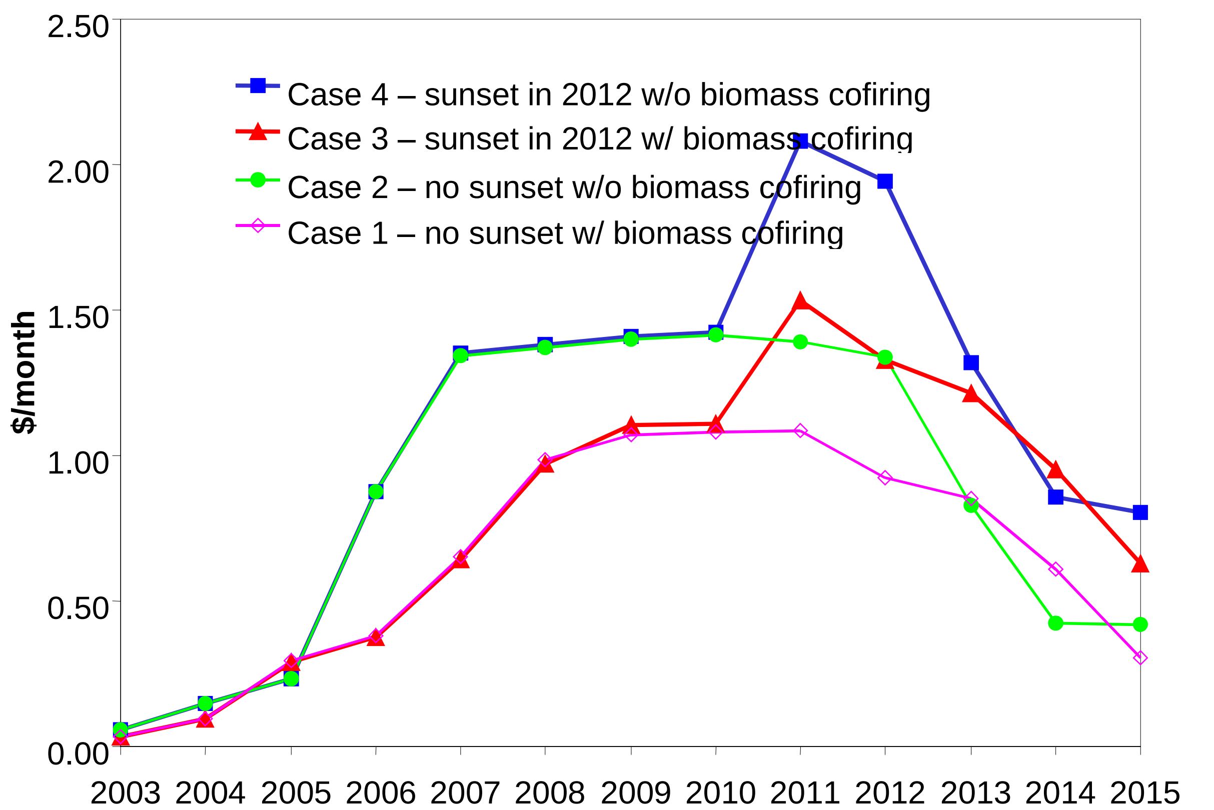
[37] This result is evident under all the scenarios that include biomass co-firing.

The result is that the average cost to consumers between 2002 and 2030 at 0.82 mills/kWh or $0.41/month more for a typical household is lower than Case 1.

Case 4 - 5*.5% RPS by 2007, RPS sunset in 2012 without biomass co-firing*

As expected, near-term costs are even higher and more volatile with a sunset and without co-firing than shown in Case 3, as more expensive biomass gasification and additional wind generation are added to meet the requirement. Interestingly, renewable generation only falls from 5.5% of total generation in 2007 to 4.5% in 2020, which is much less of a decline than Case 3. This is because the additional wind power that is added instead of some of the biomass co-firing has low operating costs compared to conventional units and is therefore dispatched whenever the wind turbines are generating electricity.

Exhibit V-1
Incremental Cost for a Typical Household
of an RPS of 5.5% by 2007 in MAAC



Case 5 - 3.5% by 2005, no sunset provision with biomass co-firing

Meeting this lower requirement results in a lower overall cost. The average rate impact is 0.6 mills/kWh between 2002 and 2030, which translates into an additional cost of $0.30/month (0.7%) for a typical household. Interestingly, while peak credit prices are slightly lower than meeting the 5.5% by 2007 target under Case 1, credit prices are slightly higher between 2004 and 2007 under this run, as shown in Exhibit V-2. The reason for this is that in Case 1, developers expect higher prices in the future as the RPS target continues to increase, which allows them to charge lower prices in earlier years. In

Case 5, the above market cost of meeting the 3.5% target falls quickly after it levels off in 2005, which gives developers an incentive to charge higher prices in the earlier years.

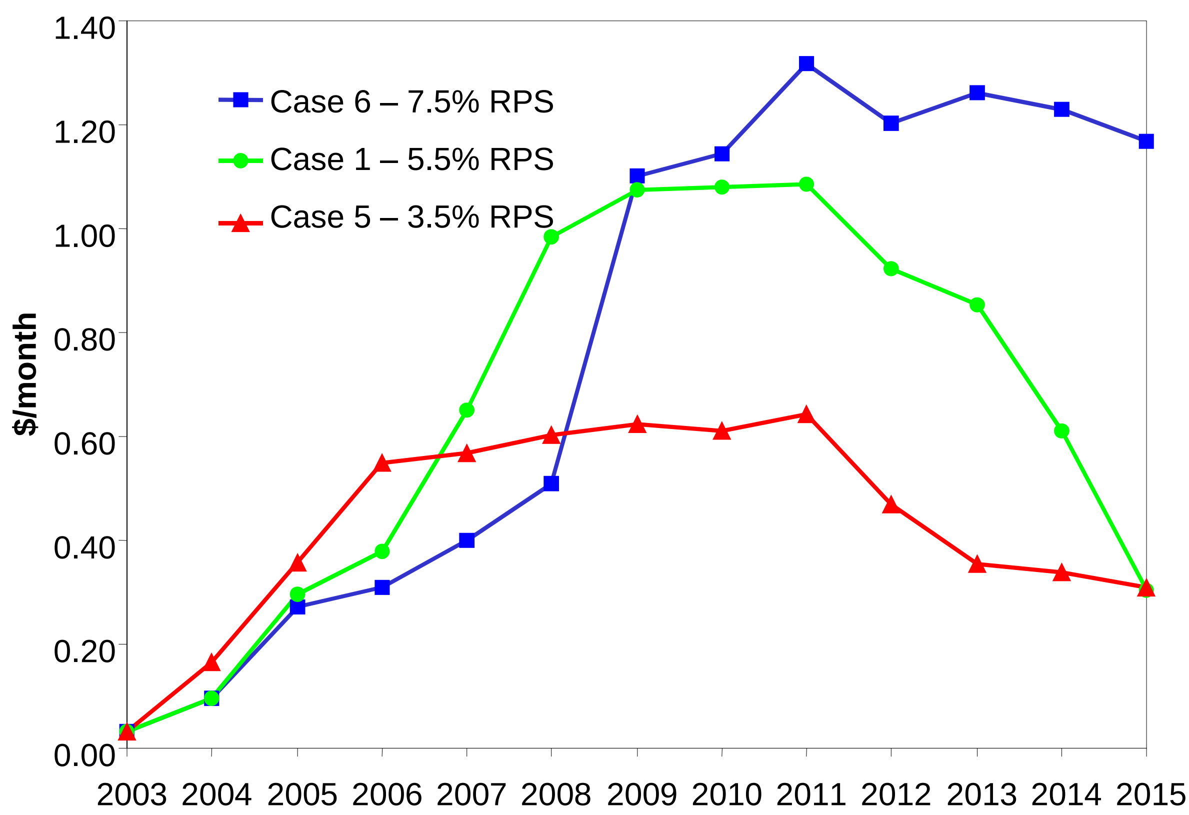
The other main difference in Case 5 is that by 2015 biomass and landfill methane captures a higher market share and wind captures a lower market share of total renewables generation than under Case 1.

Case 6 - 7.5% by 2009, no sunset with biomass co-firing)

Meeting this higher requirement would result in an average rate impact of 1.38 mills/kWh between 2002 and 2030, which translates into an additional cost of \$0.69/month (1.6%) for a typical household. As expected, the 30-year incremental cost of renewables remains higher over a longer period of time compared to the 5.5% by 2007 RPS under Case 1, as more renewables are added. Interestingly, credit prices are actually lower and less volatile through 2012 under this scenario. This is because developers know they will be able to recover more of their above market costs in the future as the targets continue to increase, thereby allowing them to charge lower prices in the earlier years compared to Case 1. The lower credit prices in the earlier years translate into lower overall costs to consumers through 2008, as shown in Exhibit V-2, despite having more renewable generation than Case 1.

This scenario also results in higher regional CO_2 savings of over 10 million metric tons by 2010. The results show that 1,240 MW of biomass co-firing is added in the MAAC region by 2009 and over 2,800 MW of wind capacity by 2014. Biomass and wind capture about 90% of the market share of total renewables generation in about equal shares with the remainder made up from landfill methane generation.

Exhibit V-2
Incremental Cost for a Typical Household of an RPS in MAAC
(assuming no sunset and with biomass cofiring)



C. Summary of Results

Table V-1 in Appendix D attached hereto, provides a summary of the rate impact per kWh for each case analyzed. The RPS with the least impact to customers is the scenario with the lowest percentage of renewables represented by Case 5. Biomass co-firing helps to reduce the costs of an RPS by lowering the initial cost of compliance through modifications to existing generation resources versus new construction (Case Nos. 1, 3, 5 and 6). A sunset provision (included in Case Nos. 3 and 4) would increase the cost of an RPS as developers attempt to recoup costs in a shorter time horizon.

Table V-2 in Appendix D displays the CO_2 reductions expected for the MAAC region with each of the possible RPS scenarios. Table V-3 in Appendix D summarizes the average monthly bill increase for a residential customer using 500 kWh per month. On average, over the period 2002 through 2015, the average monthly bill increase is estimated to be in the range of 1-2% (depending on the RPS parameters). Table V-4 in Appendix D provides the estimated costs to Maryland per year for a RPS. Table V-5 in Appendix D provides a summary for each case of the expected impact an RPS would have on generation resources. Specifically the RPS would supplement generation requirements in the future.

D. Implications for a Two-Tiered Standard

RenewMarket was not used to evaluate the impacts of a two-tiered RPS. From the analysis of the one-tiered standard, however, certain generalizations can be made. First, the costs and benefits associated with a two-tiered standard are largely dependent on the structure of the standard. For example, a single-tiered 5.5% RPS, which includes biomass co-firing, and without sunset provision, would likely produce the most affordable standard for a 5.5% standard (Case No. 1). In all six scenarios analyzed, the renewable resource mix consists of wind, biomass, and landfill methane. If, for example, the biomass co-firing were limited or capped in a two-tiered standard, in favor of a standard to promote wind and solar resources, the cost would be higher than a 5.5% single-tiered RPS, without a sunset provision but with biomass-co-firing. A two-tiered RPS that favored solar would result in higher costs. The implication of the RenewMarket model is that resources and technologies that are not the most economic choice for baseload generation do not do well within the framework of an RPS. Technologies such as photovoltaics do provide benefits during peak periods that are measured in the model.

However, the model only looks at generation and does not consider potential transmission and distribution benefits from photovoltaics.

VI. FINDINGS AND CONCLUSIONS

Based on the research and analysis presented in the foregoing sections of this report, the principal findings and conclusions are:

1. An RPS, structured as either a single-tiered or a two-tiered program, is feasible for implementation in Maryland. Other states have implemented such programs and, while concrete information regarding the efficacy of those programs based on actual experience is not yet available, the existence of RPSs in other states, at a minimum, confirms the feasibility of such a program in Maryland.

2. The RPSs that are in place in other states, or that have been proposed at the federal level, display a wide range of diversity in the mix of structural characteristics. There are numerous variations available in structuring an RPS including, but not limited to:

   - the number of years over which the maximum standard is to be attained;
   - interim standards;
   - the renewable energy technologies to be included;
   - the inclusion of sunset provisions;
   - whether Maryland projects are favored;
   - establishment of a renewables credit trading system; and
   - inclusion of a cost cap in the RPS.

3. Implementation of an RPS in Maryland will impose additional costs on Maryland consumers. The range of estimates, based on several alternative potential RPS structures (with and without sunset provisions, including and excluding biomass co-firing, and alternative levels of the standard in this statement/clause) is between 0.9 and 2.1 mills per kWh averaged over the 2002 to 2015 period. This equates to between $9.70 and $22.70 per year per residential customer based on average electricity use of 900 kWh per month. For a large commercial customer with a peak load of 5,000 kW, estimated annual cost increases under an RPS would range from

about $30,000 to $70,000. Costs would be higher under a two-tiered arrangement.

4. Benefits associated with RPS implementation include expected reductions in emissions (CO_2, SO_X, NO_X and CO), increased diversity in the mix of fuels used to generate electricity, and potential increases in employment and economic activity. It can be expected that a portion of the employment and economic benefits that could result from RPS implementation would accrue to other states in the region because Maryland has limited renewable energy sources.

6. There are other programs aimed at promoting electric energy production from renewable resources that could be used in conjunction with, or in lieu of, an RPS. These programs include Systems Benefits Funds, government purchases of electricity generated from renewables, tax incentives and grants for investment in renewables technologies and research and development, and "green power" marketing.

While implementing an RPS in Maryland is clearly feasible, important questions remain regarding its desirability and impacts. In particular, the costs associated with an RPS are seen to vary substantially even over the limited range of RPS options addressed in this analysis. The inclusion of additional requirements on an RPS, e.g., preference for in-state projects, will add further to costs.

In addition to cost impacts, the benefits associated with RPS implementation are subject to substantial uncertainty, both in terms of composition and degree. At least some of the benefits associated with the implementation of an RPS may be able to be achieved through other means (e.g., a Systems Benefits Charge or government purchases of "green power").