

Complying with Act 141: Renewable Electricity Consumption at State Facilities

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Table of Contents

List of Tables	iv
Foreword	v
Acknowledgments	viii
Executive Summary	ix
Introduction	1
Wisconsin Act 141	2
Statutory Background	2
2005 Wisconsin Act 141 Summary	3
A Synopsis of the Wisconsin Electricity Market	4
Electricity Generation	4
Statewide Electricity Market.....	5
Electricity Consumption at State Facilities.....	5
Renewable Electricity Generation and Consumption in Wisconsin.....	6
Environmental Impacts of Electricity Production in Wisconsin.....	6
Policy Alternatives in Practice: U.S. States and Other Countries	7
Assessment Rubric	8
Suggested Policy Alternatives	10
Alternative One: Purchasing Renewable Electricity from Utilities, In-State Generation.....	10
Alternative Two: Purchasing Renewable Electricity from Utilities, Out-of- State Generation.....	11
Alternative Three: State Generated Renewable Electricity.....	11
Alternative Four: Renewable Energy Certificates.....	12
Evaluation of Suggested Alternatives Using Assessment Rubric	14
Promote a Healthy Natural Environment in Wisconsin.....	15
Foster a Strong State Economy.....	17
Maximize Feasibility	19
Maximize Efficiency.....	21
Recommendation	25
Work Cited	27
Appendix A: Regulated and Deregulated Electricity Markets	33
Appendix B: Electricity Use and Emissions Calculations	34
Appendix C: Electricity Generation and Consumption in Wisconsin	36
Appendix D: State Level Renewable Fuel Portfolio Requirements (RPS)	38

Appendix E: Case Studies of States Similar in Geography to Wisconsin and a Global Review of Renewable Electricity Goals.....	42
Appendix E1: Illinois.....	42
Appendix E2: Minnesota	43
Appendix E3: Global Review	44
Appendix F: Case Studies of States with State Agency Renewable Electricity Standards.....	45
Appendix F1: New Jersey	45
Appendix F2: Maryland.....	46
Appendix F3: Oregon	47
Appendix F4: Iowa	48
Appendix F5: Pennsylvania	49
Appendix G: Technical Feasibility	51
Technical Feasibility: Alternatives One and Two — Purchasing from Utilities	51
Technical Feasibility: Alternative Three — State Generated Renewable Electricity.....	52
Technical Feasibility: Alternative Four — Renewable Energy Certificates ..	52
Appendix H: Self-Generated Renewable Electricity Capital Costs	53

List of Tables

Table 1: Origins of Wisconsin Electricity Sold by Wisconsin Utilities	4
Table 2: Fuel Sources for Electricity Generated in Wisconsin.....	5
Table 3: Assessment Rubric	9
Table 4: Evaluation of Suggested Alternatives Using Assessment Rubric.....	14
Table 5: Cost Estimates for Each Alternative.....	21
Table B-1: State Electricity Emissions A	34
Table B-2: State Electricity Emissions B	35
Table C-1: Renewable Energy Generated and Purchased in Wisconsin	36
Table D-1: State Level Renewable Fuel Portfolio Requirements.....	38
Table E-1: Renewable Energy Goals for Minnesota and Illinois.....	42
Table E3-1: Global Policies on Renewables.....	44
Table F-1: Review of States with Renewable Electricity Standards for State Facilities	45
Table H-1: Capital Costs Versus Avoided Electricity Costs Over Time.....	54

Foreword

This report presents guidance to the Wisconsin Department of Administration as its staff attempts to foster the use of renewable energy. The report offers a recommendation on the relative strengths of different options to expand the state government's consumption of renewable energy. The report is the product of collaboration between the Robert M. La Follette School of Public Affairs at the University of Wisconsin–Madison and the Division of State Facilities in the Wisconsin Department of Administration. Our objective is to provide graduate students at La Follette the opportunity to improve their policy analysis skills while contributing to the capacity of the state government to effectively provide public services to the citizens of Wisconsin.

The La Follette School offers a two-year graduate program leading to a master's degree in public affairs. Students study policy analysis and public management, and pursue a concentration in a public policy area of their choice. They spend the first year and a half taking courses that incorporate the tools needed to analyze public policies. The authors of this report are all enrolled in Public Affairs 869, Workshop in Public Affairs, Domestic Issues. Although acquiring a set of policy analysis skills is important, there is no substitute for doing policy analysis as a means of learning policy analysis. Public Affairs 869 provides graduate students that opportunity.

The students were assigned to one of eight project teams. One worked on this project for the Wisconsin Department of Administration, while three groups worked with the Budget and Management Division of the Department of Administration of the City of Milwaukee, and one team each worked with the Wisconsin Department of Revenue, the Wisconsin Department of Health and Family Services, the Wisconsin Joint Legislative Council and the U.S. Government Accountability Office. The topic of this report—an analysis of ways in which the state can increase its consumption of renewable energy—was chosen by Robert Cramer, the administrator of the Division of State Facilities.

In recent years political leadership in Wisconsin has made renewable energy a central part of the environmental policy debate. In 2005 the legislature passed Wisconsin Act 141, the “Energy Efficiency, Renewable Resources, and Energy Policy Act.” Act 141 has the general goal of promoting energy efficiency and renewable energy. One of the specific components of Act 141 is to establish goals for the purchase of renewable electricity by certain state agencies. The act sets a goal of 10 percent renewable electricity purchases by December 2007 and 20 percent by December 2011. The law tasked the Department of Administration with guiding state agencies in implementing this requirement.

This report lays out the options that the Department of Administration can pursue as it advises state agencies. In developing these options, the research team considered the regulated nature of the Wisconsin utility market, and looked to other states and other countries to identify plausible policy options that can

work for the state (extensive case examples are provided in the appendices of the report). Three main options emerged: one is to purchase renewable energy from utilities, another is to encourage state agencies to find ways to generate their own renewable energy on site, and the final option is to purchase renewable energy credits.

While environmental benefits are the primary goal of Act 141, such benefits must be balanced with other considerations. The research team assessed each option by examining not just the environmental benefits to Wisconsin, but also the likely economic effects, the administrative and political feasibility, and the immediate and long-term financial cost.

The analysis finds that the option that performs best across the different criteria is to purchase renewable energy from utilities. In addition to high feasibility and relatively low cost, the economic and environmental benefits of this option become especially strong if state utilities meet Act 141's targets by generating their renewable electricity within the State of Wisconsin. The analysis explicitly treats renewable energy purchased from utilities that source their renewable energy in state and out of state as separate options.

Because the policy options are not mutually exclusive, if utilities are unable to provide the required amount of renewable energy, the next most cost-effective and feasible option is to purchase energy credits. The option of building renewable energy sources on state government sites is least favored because it would require significant capital costs for the state and involve state supervision in an area where state purchasing is likely to foster a more efficient private market.

This report does not provide the final word on the complex issues the authors address. The authors are graduate students constrained by the semester time frame, and the topic they address is large and complex. Nevertheless, much has been accomplished, and I trust that the students have learned a great deal, and that Administrator Cramer and the staff of the Division of State Facilities will profit from the analysis.

This report would not have been possible without the support and encouragement of Administrator Cramer. A number of other people also contributed to the success of the report. Their names are listed in the acknowledgments.

The report also benefited greatly from the support of the staff of the La Follette School. Terry Shelton, the La Follette outreach director, along with Kari Reynolds, Mary Mead, and Gregory Lynch, contributed logistical and practical support for the project. Karen FASTER, La Follette publications director, edited the report and shouldered the task of producing the final bound document. I am very grateful to Wilbur R. Voigt whose generous gift to the La Follette School

supports these public affairs workshop projects. With his support, we are able to finance the production of the final reports, plus other expenses associated with the projects.

By involving La Follette students in one of the tough issues faced by Wisconsin state government, I hope the students not only have learned a great deal about doing policy analysis but have gained an appreciation of the complexities and challenges facing different levels of government in Wisconsin and elsewhere. I also hope that this report will contribute to the work of the Department of Administration and its ongoing efforts to ensure that the state government leads the way in using renewable energy.

Donald Moynihan
May 1, 2007

Acknowledgments

We are grateful for the guidance that we were given in conducting this analysis. We would like to thank Michael Vickerman for providing us with valuable background information. We would also like to thank Richard Shaten, Paul Helgeson, John Shenot and Pat Keily for the insights and data that they provided. We also appreciate the guidance and information provided by Robert Cramer. Karen Faster's editing and comments are also valued. Finally, we would like to thank Professor Don Moynihan for providing us with thoughtful comments.

Executive Summary

This report advises the Department of Administration in complying with the renewable energy targets outlined in 2005 Wisconsin Act 141, entitled the “Energy Efficiency, Renewable Resources, and Energy Policy Act.” Act 141 aims to “foster the state’s economic growth, decrease Wisconsin’s dependence on out-of-state energy, and reduce the adverse environmental impacts from fossil-fuel power plants” (Energy Efficiency, Renewable Resources, and Energy Policy Act, 2005). To help the state reach these goals, Act 141 specifically calls for the Wisconsin state government to acquire 10 percent of its electricity from renewable resources by December 31, 2007, and 20 percent by December 31, 2011. Our team seeks to aid the Department of Administration by (1) recommending policy options for meeting the 2007 target and (2) providing insight into how the 2011 target may be met. Utilizing work by the Environmental Protection Agency in collaboration with the U.S. Department of Energy, the World Resources Institute and the Center for Resource Solutions we develop four policy alternatives for Wisconsin to comply with the 2007 renewable energy targets outlined in Act 141:

- (1) purchase renewable electricity from local utilities that will invest in in-state resources to meet Act 141’s target,
- (2) purchase renewable electricity from local utilities that will invest in out-of-state resources to meet Act 141’s target,
- (3) generate renewable electricity at state facilities, and
- (4) purchase renewable energy credits.

To evaluate the strengths and weaknesses of the four alternatives, and to support our recommendation, our team employs the following assessment criteria: promote a healthy natural environment, foster a strong state economy, maximize feasibility and maximize efficiency. This analysis suggests that the first policy option — purchasing renewable electricity from local utilities that will invest in in-state resources to generate renewable electricity — is the strongest option. Of the remaining options, purchasing renewable electricity from local utilities that will invest in out-of-state resources is favored over purchasing renewable energy credits. Generating renewable electricity on site at state facilities is the poorest of the four alternatives, primarily due to its high costs and low likelihood of timely implementation.

Both alternatives that require the state to purchase renewable electricity from local utilities perform well in terms of maximizing feasibility and promoting a healthy natural environment in Wisconsin. Purchasing from local utilities that will develop renewable electricity using in-state rather than out-of-state resources has additional advantages in terms of fostering a strong state economy and maximizing efficiency. When utilities use in-state resources to generate electricity, Wisconsin reduces its dependence on out-of-state energy and in-state

jobs are created. Additionally, in-state generation by utilities promotes the long-term cost efficiency of renewable electricity consumed in Wisconsin.

It is possible that even with a combination of in-state and out-of-state generation Wisconsin utilities will not be able to supply sufficient amounts of renewable electricity for the state to comply with Act 141. In this circumstance, we recommend that the state purchase renewable energy credits to satisfy any remaining deficit. Major advantages of purchasing renewable energy credits relative to generating electricity on-site at state facilities include lower costs and higher feasibility.

Introduction

Our client Robert Cramer, administrator of the Division of State Facilities at the Wisconsin Department of Administration (DOA), requested that our team prepare this report to aid the State of Wisconsin in fulfilling the renewable energy targets outlined in 2005 Wisconsin Act 141, entitled the “Energy Efficiency, Renewable Resources, and Energy Policy Act.” Act 141 was published on March 31, 2006. By overhauling the statewide energy efficiency program and establishing a Renewable Fuel Portfolio Standard, the law aims to “foster the state’s economic growth, decrease Wisconsin’s dependence on out-of-state energy, and reduce the adverse environmental impacts from fossil-fuel power plants” (Energy Efficiency, Renewable Resources, and Energy Policy Act, 2005). To help the state reach these goals, Act 141 specifically calls for the Wisconsin state government to acquire 10 percent of its electricity from renewable resources by December 31, 2007, and 20 percent by December 31, 2011. It stipulates that DOA be responsible for ensuring that the departments of Corrections, Health and Family Services, Public Instructions, Veterans Affairs and Administration, and the Board of Regents for the University of Wisconsin System establish a consistent set of goals to achieve the required renewable electricity consumption levels (Energy Efficiency, Renewable Resources, and Energy Policy Act, 2005).

This report focuses on DOA’s role in meeting the renewable targets for the Wisconsin state government set forth by Act 141. Our team aims to aid DOA by recommending policy options for meeting the 2007 target. The group’s recommendation provides insight into how the 2011 target may be met. Actual recommendations for meeting the 2011 target are not made in this report because renewable electricity technology is advancing rapidly.¹ The method by which the state chooses to fulfill the 10 percent target for 2007 will not positively or negatively affect its choices in meeting the additional 10 percent needed for 2011. As our client requested, we provide appendices detailing legislation that other states and countries have passed concerning governmental consumption of renewable electricity and how these governments have satisfied the requirements of such legislation.

Our report begins with a background of Act 141 and an overview of the requirements it sets for DOA. We then provide a review of Wisconsin’s current electricity market and an overview of renewable electricity programs in other states and countries. Next, we introduce an assessment rubric and propose policy alternatives for the State of Wisconsin to meet the 2007 target set by Act 141. We use this multigoal analysis to evaluate these policy alternatives before making a final recommendation.

¹ We expect technological advances and market expansion will alter the strengths and weaknesses of policy alternatives for meeting the Act 141 target for 2011. The U.S. Department of Energy is working with the wind industry to advance renewable technologies. In recent years, renewable technology has drastically expanded and improved (U.S. Department of Energy, 2006). We are confident experts will continue to advance this technology, and DOA will be faced with different infrastructure options and cost projections for 2011. Also, the market for renewable electricity may significantly change prior to 2011 due to state or federal legislation, such as a carbon tax.

Wisconsin Act 141

To provide a better understanding of the issue we are addressing, we first offer background information on Act 141. This section begins with a summary of the legislation that preceded the passage of the Act.² We then discuss Governor Jim Doyle's Task Force on Energy Efficiency and Renewables (Task Force). Next, we provide details on the sections of Act 141 that address Wisconsin's renewable electricity policy.

Statutory Background

In 1993 the Wisconsin legislature passed Wis. Stat. 1.12(4). Commonly known as the Energy Priorities Law, this statute formally made conserving electricity and increasing the amount of energy generated from renewable resources top priorities of the state's energy policy (Energy Priorities Law, 1993). A major weakness in the legislation was that it did not identify specific targets for use of renewable resources or "offer a ready-made prescription for implementing the law" (Governor's Task Force on Energy Efficiency and Renewables [Task Force], 2004, p.9).

Six years later, the Wisconsin legislature took steps toward specifying how its energy goals should be implemented. The Reliability 2000 Initiative mandated all electric utilities to generate 2.2 percent of their retail electricity sales from renewable resources by the end of 2011 (Wisconsin Legislative Reference Bureau, 1999).

While the Reliability 2000 Initiative attempted to specify the level to which electric utilities must use renewable resources, the problem of policy implementation remained unresolved. To improve the clarity and organization of Wisconsin's energy policy, Governor Doyle assembled the Task Force to study the issue and make concrete legislative and policy recommendations concerning both electricity conservation and the use of renewable energy throughout the state (Task Force, 2004, p. 9).

The Task Force determined that the state should establish stronger renewable energy goals with a clearer implementation plan. The Task Force found that increasing the percentage of electricity that comes from renewable energy is one of the most effective ways for Wisconsin to reach its state energy goals. As such, the Task Force recommended a statewide Renewable Fuel Portfolio Standard requiring that 10 percent of all electricity sold in Wisconsin be generated from renewable energy resources by 2015 (Task Force, 2004, p. 35). Because the Task Force believed state leadership to be imperative in reaching this goal, it stipulated that state agencies should take the lead in reaching or exceeding the recommendations put forth by the Task Force.

² 2005 Wisconsin Act 141 was formally introduced as Senate Bill 459.

2005 Wisconsin Act 141 Summary

Act 141 incorporates many of the recommendations suggested by the Task Force, including the use of renewable electricity by state agencies. Act 141 compels the state to take the lead in purchasing renewable electricity. To this end, Act 141 mandates that 10 percent of all electricity used by state agencies comes from renewable resources by the end of December 2007, with an increase to 20 percent by the end of December 2011 (Wis. Stat. 16.75(12)(b), 2005). Since these goals are for overall consumption at state government facilities, each facility is not individually required to meet these goals.

Act 141 defines a “renewable resource” as “a resource that derives energy from any source other than coal, petroleum products, nuclear power or, except as used in a fuel cell, natural gas.” Thus, renewable resources include solar energy, wind power, water power, biomass, geothermal technology, tidal or wave action and, as determined by the Public Service Commission, fuel cell technology that uses a renewable fuel (Wis. Stat. 196.374(1)(j), 2005). The legislation specifies that the renewable electricity come from one of two possible providers:

- (1) electricity providers that “serve an agency facility under an agreement with a term of ten years or more” or
- (2) “derived from renewable resources owned by the state and produced for use in the state agency” (Wis. Stat. 16.75(12)(c), 2005).

To demonstrate compliance, or to document non-compliance, the statute requires that DOA submit an annual report to the governor and both houses of the Wisconsin legislature (Wis. Stat. 16.75(12)(e), 2005). This report must discuss in detail the degree to which DOA has or has not satisfied the state’s renewable energy goals (Wis. Stat. 16.75(12)(3), 2005). If DOA fails to reach these goals in any given year, the report must give a detailed explanation for its failure (Wis. Stat. 16.75(12)(e), 2005).

While the legislation is straightforward in its expectations of DOA, one subsection of the statute may be viewed as a general escape clause. Subsection (d) of Wis. Stat. 16.75(12) permits any or all state agencies (as represented by DOA) not to purchase or generate electricity from renewable resources if “the generation or purchase is not deemed feasible or cost-effective” (2005). In the context of discussing “cost-effective” energy programs, it may be argued that the purchase or generation of non-renewable energy frequently has a lower direct monetary cost than renewable energy. This report, however, focuses on how renewable targets can be met and does not compare costs of renewable versus conventional electricity.

A Synopsis of the Wisconsin Electricity Market

This section serves two purposes. First, it provides context for the situation that DOA faces in its task of increasing consumption of renewable electricity at state facilities. Second, knowledge of these issues is necessary to understand the viability of implementing policy options. We provide an overview of

- (1) electricity generation in Wisconsin,
- (2) the Wisconsin electricity market,
- (3) electricity consumption at state facilities,
- (4) renewable electricity generation and consumption in Wisconsin, and
- (5) environmental impacts of electricity production.

Electricity Generation

Wisconsin utilities sold 70.4 billion kilowatt-hours (kWh)³ of electricity in 2005. Over the last ten years electricity sales averaged an annual growth rate of 2 percent (Wisconsin Department of Administration [WDOA], 2006, p.46). Of this electricity, 76 percent was produced by local utilities, 6 percent was produced in-state by independent power producers, while 18 percent was imported from out-of-state. Of the electricity generated by Wisconsin utilities, coal-powered energy sources produced nearly 76 percent, while nuclear-powered sources generated an additional 17 percent. Approximately 3 percent of the state's electricity came from renewable energy sources (WDOA, 2006, p.53). Table 1 summarizes electricity generation by producer, and Table 2 summarizes generation by energy source.

Table 1: Origins of Wisconsin Electricity Sold by Wisconsin Utilities

	Billion kWh	Percentage of total kWh
Produced in-state by utilities	53.7	76
Produced in-state by independent power producers	3.9	6
Imported from out-of-state	12.7	18
Source: WDOA, 2006, p. 53		

³ A kilowatt (1,000 watts) is a unit of power. That amount of power measured in one hour yields a kilowatt-hour, a common unit for measuring electrical energy. For perspective, the average Wisconsin home consumed approximately 8,900 kWh of electricity in 2005 (calculation made from data provided by WDOA [2006, p.59]).

Table 2: Fuel Sources for Electricity Generated in Wisconsin

	Billion kWh	Percentage of total kWh
From coal	40.8	76
From nuclear	9.1	17
From oil or natural gas	2.1	4
From renewables	1.6	3
Source: WDOA, 2006, p. 53		

Statewide Electricity Market

A fundamental aspect of the Wisconsin electricity market is that it remains regulated. As such, in-state consumers (including state facilities) have only one supplier from whom they may purchase electricity. This affects the feasibility of policy options for purchasing renewable electricity at state facilities because individual facilities may not simply purchase from the supplier charging the lowest price. A more extensive discussion of regulated and deregulated electricity markets can be found in Appendix A.

The Wisconsin electricity market is regionalized in nature. Four utilities constitute a large share of the overall market: Alliant Energy serves Central and Southwest Wisconsin; We Energies serves the Southeast portion of the state; Wisconsin Public Service Corporation provides electricity to most of Northeast Wisconsin; Xcel Energy serves multiple, small areas in the western part of the state. Beyond these large providers, dozens of smaller utilities, cooperatives and municipal utilities supply electricity in the state (Wisconsin Public Service Commission, 2002).

Electricity Consumption at State Facilities

Electricity use in state-owned buildings totaled 896 million kWh in 2005, approximately 1.3 percent of statewide electricity use.⁴ To pay for this electricity, Wisconsin's state government expended approximately \$70 million in 2005.⁵ Utilizing the 896 million kWh total, the 10 percent renewable electricity required by Act 141 amounts to 89.6 million kWh. Given the annual growth rate of 2 percent (WDOA, 2006, p.46), DOA's estimated 2007 renewable electricity needs will be 93.2 million kWh. Through the remainder of this report we assume DOA must purchase 93.2 million kWh of renewable electricity to meet the 2007 target of Act 141.

⁴ Please see Appendix B for the calculations.

⁵ State government paid \$70,511,050 for electricity in fiscal year 2006 (WDOA, 2007, p.42). Although the available electricity consumption data is organized by the 2005 calendar year, (January 2005 – December 2005) the financial information is organized by the 2006 fiscal year (July 2005 – June 2006). Because of this six-month misalignment in reporting periods and the likely variation in weather and fuel prices between January 2005 – June 2005 and January 2006 – June 2006, we are forced to offer a rough estimate.

Renewable Electricity Generation and Consumption in Wisconsin

In comparison, 2,521 million kWh of renewable electricity was generated and purchased in Wisconsin in 2005 (WDOA, 2006, p. 69) Wisconsin has an abundant supply of resources for expanding generation of renewable electricity. Wisconsin utilities, cooperatives and private organizations produce electricity from hydro-electric dams, wood, biosolid waste, biogas resources, wind and solar resources. Wind power has great potential for expansion in Wisconsin, along with electricity generated from biogas and biosolid waste (Union of Concerned Scientists, 2007). A discussion of renewable resources and their potential to aid in meeting requirements set by Act 141 is available in Appendix C.

Environmental Impacts of Electricity Production in Wisconsin

Although electricity is vital for the functioning of our economy and society, its generation comes with many environmental costs. The 1990 Clean Air Act Amendments list 188 toxic air pollutants the Environmental Protection Agency (EPA) is required to control (EPA, 2007a), but the legislation requires the agency to establish National Ambient Air Quality Standards for only six “criteria” pollutants: ozone, particulate matter, carbon monoxide, nitrogen oxide, sulfur dioxide and lead (EPA, 2007b).⁶ According to the Wisconsin Department of Natural Resources (DNR), Wisconsin’s conventionally fueled power generators emitted the following approximate amounts of criteria pollutants in 2005: 44 million pounds of particulate matter, 228 million pounds of nitrogen oxide and 731 million pounds of sulfur dioxide. These same power generators also emitted approximately 237 billion pounds of carbon dioxide and 7,000 pounds of mercury.⁷

To calculate emission reductions derived from decreased electricity consumption, DNR has elected to provide estimates for two criteria pollutants — nitrogen oxide and sulfur dioxide — in addition to carbon dioxide and mercury emissions. As such, we follow DNR’s lead in estimating of reductions of these same four pollutants throughout our analysis. State facilities’ 2005 electricity consumption resulted in emissions of approximately 3.8 million tons of nitrogen oxide, 7.3 million tons of sulfur dioxide, 1,659 million tons of carbon dioxide and 30 pounds of mercury.⁸ Shifting the source of a portion of this electricity from conventional to renewable resources would reduce quantities of these pollutants, one of the key goals of Act 141.

⁶ These six are known as “criteria” pollutants because EPA regulates them by developing human-health based and/or environmental-based criteria before establishing allowable levels (EPA, 2007b).

⁷ This data was provided by John Shenot, sector specialist, Wisconsin Department of Natural Resources. The data was collected from the DNR’s in-house database of air pollution emissions using in-house software and then transferred to an Excel spreadsheet for purposes of personal communication on February 28, 2007.

⁸ Please see Appendix B for this calculation.

Policy Alternatives in Practice: U.S. States and Other Countries

The following discussion of the renewable-electricity purchasing programs other states and countries pursue:

- (1) provides insight into Wisconsin's relative status in setting renewable electricity targets and
- (2) details restrictions Wisconsin faces in developing alternatives to meet the renewable targets set by Act 141.

Twenty-six of the 50 U.S. states have adopted some form of policy regarding statewide consumption of renewable electricity resources. The majority fulfill this goal by requiring all state utilities to derive a percentage of their electricity through renewable energy — a Renewable Fuel Portfolio Standard (RPS).

We are aware of only five states — New Jersey, Maryland, Oregon, Iowa and Pennsylvania — that have passed legislation similar to Wisconsin's Act 141 in that they place additional restrictions on the electricity that state facilities use.

Because of variation among policies to increase the consumption of renewable resources, this analysis includes three forms of case studies regarding state renewable electricity policies. Appendix D provides a summary of the RPS requirements for each U.S. state. Appendix E discusses the renewable electricity policy in Illinois and Minnesota, two states whose geographic makeup is similar to that of Wisconsin. It also examines three countries with unique renewable electricity policies: Spain, Germany and Denmark. Finally, Appendix F analyzes the five states that require their state facilities to derive a certain percentage of their electricity from renewable resources.

By reviewing the renewable electricity policies other states and countries pursue, the case studies demonstrate Wisconsin's relative status regarding its consumption of renewable electricity. Nonetheless, Wisconsin law limits the alternatives its state agencies can pursue to meet its renewable energy goals; other states do not face the same bounds. For example, the act poses the following stipulations on energy counted toward meeting Wisconsin's renewable electricity goal:

For any individual agency facility, consider only electric energy that is purchased from the electric provider that serves the agency facility under an arrangement with a term of 10 years or more and electric energy derived from renewable resources owned by the state and produced for use in the agency facility (Energy Efficiency, Renewable Resources, and Energy Policy Act, 2005).

Additionally, policy alternatives for Wisconsin must be feasible in the context of a regulated electricity market.

Assessment Rubric

We develop an assessment rubric to evaluate the strengths and weaknesses of policy options for meeting the 2007 renewable electricity target set by Act 141. The criteria for this assessment rubric were developed from three sources. The Governor's Task Force on Energy Efficiency and Renewables final report was the first. The report outlined three primary and two secondary goals around which it designed the renewable resource requirement for state agencies (2004). The primary goals include fostering Wisconsin's economic growth, decreasing Wisconsin's dependence on out-of-state energy and reducing the adverse environmental impacts from fossil fuels. Through its secondary goals, the Task Force hoped to establish popular policies and to protect Wisconsin's natural resources. An effective assessment rubric must, therefore, sufficiently address each of these five goals.

The State of New York produced our second source for the rubric. As the State of New York considered the strengths and weaknesses associated with the development of a statewide RPS, it used several assessment criteria that are pertinent to this project (Grace, Bolinger, & Wiser, 2005, p. 30). The New York analysis examined whether the policy fosters development of renewables, the likelihood that the policy receives full compliance, whether it yields reasonable and stable costs of electricity, and whether the supply of renewable resources is diverse. Even though DOA is not concerned with evaluating a statewide RPS, the New York assessment criteria are nonetheless useful in discussing the policy options for Wisconsin.

Finally, the U.S. Department of Energy (DOE) sponsored a study evaluating the effects a national RPS would have on the country (Kydes, 2007, p.809). Again, this study is enlightening not because of its results as they relate to the RPS, but rather for the criteria it used to analyze the potential policy. Accordingly, DOE looked at the effect the policy would have on the United States' dependence on foreign energy, its ability to reduce damaging environmental emissions, its saving of depletable resources for future generations and its promotion of long-term cost-effectiveness of alternative technologies.

Table 3 synthesizes the criteria used in the three aforementioned sources. In total, we utilize four goals: Promote a Healthy Natural Environment in Wisconsin, Foster a Strong State Economy, Maximize Feasibility and Maximize Efficiency. Within each goal, we use impact categories to analyze each alternative.⁹ Of particular note is the impact category: *Promote long-term cost efficiency of renewable electricity consumed in Wisconsin*. This criterion encapsulates the desire to provide low-cost renewable electricity for Wisconsin consumers and to maximize the development of new renewable electricity infrastructure in Wisconsin.

Table 3: Assessment Rubric

Goal	Impact Category
Promote a Healthy Natural Environment in Wisconsin	Minimize Wisconsin’s exposure to harmful pollutants
Foster a Strong State Economy	Minimize Wisconsin’s dependence on out-of-state energy
	Maximize the number of new state jobs
Maximize Feasibility	<i>Administrative:</i> Minimize DOA regulatory oversight costs
	<i>Political:</i> Maximize political support based on successful adoption in other states
Maximize Efficiency	Promote long-term cost efficiency of renewable electricity consumed in Wisconsin
	Minimize dollar cost per kWh paid by DOA

⁹ We initially evaluated the technical feasibility of implementing each alternative by the December 31, 2007, deadline, but ultimately removed the discussion from the evaluation. We are unable to differentiate between the technical feasibility of the first two alternatives, but we do discuss the feasibility of implementing both alternatives together. Because the alternatives are not mutually exclusive, a single alternative’s ability to fully meet Act 141 targets does not alter our final recommendation. For a full discussion of technical feasibility, see Appendix G.

Suggested Policy Alternatives

This report utilizes four policy alternatives suggested in a report produced by the U.S. Environmental Protection Agency in collaboration with the U.S. Department of Energy, the World Resources Institute and the Center for Resource Solutions (EPA, 2004). The four alternatives we outline in this section are

- (1) purchase renewable electricity from local utilities that will invest in in-state resources to meet Act 141's target,
- (2) purchase renewable electricity from local utilities that will invest in out-of-state resources to meet Act 141's target,
- (3) generate renewable electricity at state facilities, and
- (4) purchase renewable energy credits.

Based on our analysis, we recommend the state purchase renewable electricity from local utilities that will invest in in-state resources to meet Act 141's target.

We analyze these alternatives with respect to the assessment criteria in the following section. Although the alternatives are not mutually exclusive, this report presents them individually for clarity. Indeed, we recognize that DOA's ultimate purchase of renewable electricity may include a combination of the four alternatives. Nonetheless, we proceed to analyze each alternative and then provide a complete analysis, including a discussion of combining multiple alternatives, in our final policy recommendation.

Alternative One:

Purchasing Renewable Electricity from Utilities, In-State Generation

Alternative One requires Wisconsin state facilities to purchase renewable electricity from local utilities that will invest in in-state resources to meet Act 141's target. Because the renewable electricity target outlined by Act 141 is a collective goal, individual facilities do not each need to obtain 10 percent of their electricity from renewable sources. Since DOA must ensure that state facilities collectively meet the 10 percent goal, it is responsible for purchasing the requisite amounts of renewable electricity from the most appealing offers put forth by Wisconsin utilities. The renewable electricity DOA purchases to meet the requirements of Act 141 is a percentage of the total electricity consumed by state facilities, resulting in the purchase of a blend of conventional and renewable power. The State of Wisconsin and the electricity utilities would negotiate rates based on the proposed quantity of electricity and the length of contract. These negotiated rates would need Public Service Commission approval to become binding (Helgeson, personal communication, March 28, 2007).

Alternative Two:**Purchasing Renewable Electricity from Utilities, Out-of-State Generation**

Alternative Two is virtually identical to Alternative One, except that Alternative Two requires Wisconsin utilities to invest in out-of-state resources to meet Act 141's target for 2007.¹⁰ Even though Wisconsin's regulated market stipulates that all Wisconsin consumers must purchase their electricity from local utilities, the utilities are free to generate the electricity outside of Wisconsin and transport it onto Wisconsin's power grid. Because such out-of-state generation yields different benefits than those achieved when utilities generate their electricity in Wisconsin, we analyze these alternatives separately. In doing so, we recognize that DOA holds little ability to specify whether utilities direct their investment in renewable electricity generation in-state or out-of-state.

Alternative Three: State Generated Renewable Electricity

Under Alternative Three, electricity would be generated at select state facilities. State facilities best suited for self-generation would be determined by expert analysis. DOA would be responsible for ensuring that the specified sites develop and operate their self-generation apparatuses. Total generation levels would be targeted to 10 percent of electricity consumption at all state facilities by the end of December 2007. Possible on-site renewable electricity options include photovoltaic panels, wind turbines, biogas and biomass combustion. When offering cost estimates and addressing feasibility, we make the assumption that wind turbines will be used. Our assumption is based on resource potential in Wisconsin (see Appendix C); the decisions made by states with similar wind resources to use wind power to meet RPS goals (see Appendix E); and the low cost of wind relative to other renewable technologies (Energy Information Administration, 2007a, p.3). Assuming that the new renewable electricity will come from wind turbines does not affect Alternative Three's performance relative to promoting a healthy natural environment or fostering a strong state economy.

To pursue this alternative, DOA could choose to have government officials at the state facilities construct and maintain the renewable generators, or to contract out the construction and maintenance work to a private party. If it chooses to use in-house employees to oversee renewable generation, DOA should utilize the 32 state facilities (representing six agencies) that currently employ their own heating and cooling crews (Cramer, personal communication, April 12, 2007). The engineers at each facility would likely be able to assist in the renewable electricity generation. Additional hires would no doubt be necessary, yet the heating and cooling specialists should provide a starting ground from which the facilities could generate their own renewable electricity.

¹⁰ We suggest that a wind farm in Iowa or Minnesota is the most likely scenario.

If facilities contract out the project, the generators and the land on which they stand would remain government property. Similar to state facilities that hire private janitorial services to clean the buildings, the facilities could hire private engineers to oversee the electricity generation. Pursuing this route would allow the state to select from a wider range of electricity providers than Wisconsin utilities.

Except for the difference in cost, using in-house or private employees to generate on-site renewable electricity would yield similar benefits.¹¹ With respect to the disparate costs, we are unable within the confines of this report to estimate how much private electricity suppliers would charge to manage the generation of renewable electricity on state property. Because we are unaware of other states pursuing private on-site generation, a reasonable estimate of its costs is unavailable. We predict that the broad range of potential private suppliers would help reduce the price DOA pays, but to make a legitimate approximation, DOA would have to solicit bids for such production. Without an estimate, we cannot differentiate the two options based on costs, thereby rendering the two options identical for the purposes of this analysis. In proceeding, we analyze Alternative Three under the assumption that the state stays in-house for its on-site generation, but we note that private on-site generation remains a viable option.

Additionally, we find it important to note that Alternative Three would be technically infeasible for Act 141's 2007 deadline (see Appendix G). Alternative Three is the only one of the four alternatives whose implementation would be impossible to complete by the end of December 2007. We include on-site generation in this analysis for a fuller understanding of policy options the state may pursue in the future. Additionally, if the Act 141 2007 deadline were postponed, on-site generation would become a technically feasible option.

Alternative Four: Renewable Energy Certificates

Renewable energy certificates (RECs) are privately sold certificates from renewable energy producers that represent the benefits of renewable energy (separate from the actual electricity). When purchasing RECs, the consumer pays for the premium that accounts for the environmental benefits of renewable electricity generation. The consumer continues to purchase conventional electricity as well. RECs enable facilities to get credit for purchasing renewable

¹¹ To support this assertion, we assume the environment will be equally affected whether the same amounts of renewable electricity, generated in an identical manner in the same geographic location, is achieved via private or public means. With respect to the impact on Wisconsin's economy, both options would equally reduce the state's dependence on out-of-state electricity and both would require a comparable number of new employees. Regarding feasibility, DOA would be setting up and overseeing the program either way. The difference in the magnitude of oversight required would depend on how DOA structures the program. Although it remains possible that one option would require less DOA oversight than another, we are unable to make a reasonable estimate; we thereby treat the two options identically with respect to minimizing DOA's regulatory oversight. Finally, we assume both options to be equally likely to achieve political support.

electricity when a local electric provider is unable to supply it or when a provider charges a substantial premium. For example, a Wisconsin resident who uses 100 kWh of electricity could purchase RECs representing 100 kWh worth of renewable energy from a private supplier in another state — e.g. a privately owned wind-farm. Even though the electricity used in the Wisconsin resident’s home would technically be non-renewable, the RECs enable the Wisconsin resident to “get credit” for consuming renewable energy. From the wind-farm owner’s standpoint, after the environmental benefits of the renewable energy are sold, the electricity (generated by the wind turbine) is no longer considered renewable and is sold at the market rate for conventional electricity.

Although ambiguity remains over whether RECs satisfy the requirements of Act 141, we believe they are permissible. Act 141 clearly stipulates that only “energy that is purchased from the electric provider that serves the agency facility” and electricity generated from renewable resources owned by the state may be counted toward meeting Act 141 targets (Energy Efficiency, Renewable Resources, and Energy Policy Act, 2005). By purchasing RECs, DOA would be purchasing a premium for renewable electricity and the producer of such energy would then constitute an electricity provider serving the agency facility. Although the producer would not technically supply electricity, it would supply renewable credits. Alternatively, utilities within Wisconsin could purchase RECs and sell conventional electricity credited as “renewable.” It remains possible that legal energy experts may claim that RECs would not be allowed, in which case this alternative would need to be removed.

Evaluation of Suggested Alternatives Using Assessment Rubric

In this section we evaluate policy alternative using the assessment rubric in Table 3. Qualitative analysis of implementation is offered throughout; where possible, we quantified costs and benefits. We assign a ranking of **poor**, **fair**, **good** or **excellent** to reflect how well each alternative performs relative to the other three. This section is organized by assessment criteria, with each criterion followed by an assessment of each alternative relative to that criterion. Table 4 summarizes our findings.

Table 4: Evaluation of Suggested Alternatives Using Assessment Rubric

Goal	Impact Category	Alternatives			
		<i>Purchasing Renewable Electricity from Utilities; In-State Generation</i>	<i>Purchasing Renewable Electricity from Utilities; Out-of-State Generation</i>	<i>State Generated Renewable Electricity</i>	<i>Renewable Energy Certificates</i>
Promote Healthy Natural Environment in Wisconsin	<i>Minimize Wisconsin's Exposure to Harmful Pollutants</i>	Good	Good	Good	Poor
Foster a Strong State Economy	<i>Minimize Wisconsin's Dependence on Out-of-State Energy</i>	Excellent	Poor	Excellent	Poor
	<i>Maximize the Number of New State Jobs</i>	Excellent	Fair	Excellent	Poor
Maximize Feasibility	<i>Administrative: Minimize DOA Regulatory Oversight Costs</i>	Excellent	Excellent	Poor	Excellent
	<i>Political: Maximize Political Support Based on Adoption by Other States</i>	Excellent	Excellent	Poor	Fair
Maximize Efficiency	<i>Promote Long-Term Cost Efficiency of Renewable Electricity Consumed in Wisconsin</i>	Excellent	Good	Fair	Poor
	<i>Minimize Dollar Cost per kWh Paid by DOA</i>	Excellent	Good	Poor	Good

Promote a Healthy Natural Environment in Wisconsin

The first goal of the policy alternatives is to promote a healthy natural environment in Wisconsin. The success of the alternatives in accomplishing this goal is determined by minimizing the state's exposure to these harmful pollutants: nitrogen oxide, sulfur dioxide, carbon dioxide and mercury.

This discussion of the emission of these four pollutants must include our level of uncertainty as well as our assumptions. One important uncertainty to note is the effect the renewably generated electricity will have on the rest of the Wisconsin electricity grid. New renewable electricity may prompt a direct, corresponding reduction in conventionally generated electricity in Wisconsin. In-state generation might continue as usual while the importation of electricity from other states decreases. Conventionally fueled in-state generation and electricity importation may continue as usual and the renewably generated electricity may meet new growth in demand. The different scenarios would result in varying levels of state exposure to harmful pollutants. The factors determining the actual effect are economic and technical. However, because of cost differentials, we believe a reduction in importation of electricity generated from outside Wisconsin is the most likely outcome.¹² *Assumption One: additional electricity generated with renewable resources will replace electricity imported from out-of-state.*

While we are unable to identify all locations from which Wisconsin imports electricity, we identify the Midwest as the region from which the imports likely originate. Wisconsin is part of the Midwest Independent Transmission System Operator (MISO).¹³ *Assumption Two: electricity Wisconsin imports from out of state comes from within the MISO region, so renewably generated electricity will reduce the amount of conventionally fueled electricity generated somewhere within MISO region.* Thus, the corresponding pollution reductions also will occur somewhere within this region.

We also face uncertainty about the dispersion of air pollution. According to the EPA, "The transport and dispersion of air pollutants in the ambient air are influenced by many complex factors" (EPA, 2006).¹⁴ The EPA classifies

¹² See the evaluation of Alternative One within the analysis of "Fostering a Strong State Economy."

¹³ The MISO region covers Manitoba, the Dakotas, Nebraska, Minnesota, Iowa, parts of Missouri, Wisconsin, most of Illinois and Indiana, and nearly all of Michigan. According to the "About Us" page on the MISO website, "The Midwest ISO is an independent, nonprofit organization that supports the constant availability of electricity in 15 U.S. states and the Canadian province of Manitoba. This responsibility is carried out by ensuring the reliable operations of nearly 94,000 miles of interconnected high voltage power lines that support the transmission of more than 100,000 MW [megawatts] of energy in the Midwest, by administering one of the world's largest energy markets, and by looking ahead to identify improvements to the wholesale bulk electric infrastructure that will best meet the growing demand for power in an efficient and effective manner" (Midwest Independent Transmission System Operator, 2004).

¹⁴ EPA says these factors can affect air pollution dispersion: global and regional weather patterns, local topographical wind conditions, local atmospheric stability, and smokestack height and features (EPA, 2006).

sulfur dioxide and nitrogen oxide as regional pollutants because they can travel hundreds of miles. Mercury is classified as a regional and global pollutant for the same reason (EPA, 2007c; 2007d; 1998, p.2). Carbon dioxide is a global pollutant. Given these properties, we make our third assumption. *Assumption Three: reductions of these four pollutants, stemming from reduced conventionally fueled electricity generation in the MISO region, will affect Wisconsin.* Consequently, Wisconsin will recognize benefits from a reduction in these pollutants. We cannot say which percentages of the pollutant reductions (or the resultant benefits) would directly affect Wisconsin, so we rely on the previously described ranking system.

Alternative One:

Purchasing Renewable Electricity from Utilities, In-State Generation

Using predicted 2007 electricity consumption, we calculate that if state agencies use renewable electricity for 10 percent of their overall electric consumption, nitrogen oxide emissions would decrease 0.4 million tons, sulfur dioxide emissions would decrease 0.8 million tons, carbon dioxide emissions would decrease 172.6 million tons, and mercury emissions would decrease 3 pounds.¹⁵ Our assumptions allow us to state that Wisconsin would benefit from the use of renewable energy because these pollutant reductions would occur somewhere in the MISO region. Given the overall level of uncertainty, we rank purchasing renewably generated electricity from utilities that will invest in in-state resources as having a **good** impact on minimizing Wisconsin's exposure to harmful pollutants.

Alternative Two:

Purchasing Renewable Electricity from Utilities; Out-of-State Generation

As noted, this alternative is virtually identical to Alternative One except that a Wisconsin utility would invest in renewable electricity resources outside state lines. Again, our assumptions that imports originate within the MISO region and that a reduction in emissions will affect Wisconsin enable us to estimate Alternative Two would perform equivalently to Alternative One in minimizing Wisconsin's exposure to harmful pollutants. We rank it **good** as well.

Alternative Three: State Generated Renewable Electricity

In evaluating state generation of renewable electricity for its likelihood of minimizing exposure to harmful pollutants, we face the same uncertainties. Indeed, in terms of this goal and impact category, most aspects of Alternative Three are parallel to Alternatives One and Two. Alternative Three is also ranked **good**.

Alternative Four: Renewable Energy Certificates

Significant uncertainty exists regarding Alternative Four — the purchase of RECs. This uncertainty stems from the varying locations of facilities that generate RECs. If the facility is within the MISO region, reduced pollutants likely would

¹⁵ Please see Appendix B for this calculation

affect Wisconsin; therefore the state would enjoy benefits from this alternative to the same degree as Alternatives One through Three. Thus we would rank Alternative Four good. However, if the REC facility is located outside this region, reductions in sulfur dioxide, nitrogen oxide or mercury are much less likely to affect Wisconsin. (Carbon dioxide reductions would still affect Wisconsin and it would still be possible for mercury to as well, although its effects are less certain.) Under this scenario we would rank Alternative Four as poor.

REC facilities are most often found in geographic areas favorable to renewable generation, usually with ideal solar or wind conditions. Favorable solar conditions are most common in the Southwest. Favorable wind conditions are common along the U.S. coasts and in Texas, but also the central Plains States, including several in the MISO region. Although it may be possible to acquire RECs that allow for the benefits of reduced pollutants, the most likely scenario is for the RECs to originate outside of the MISO region. We rank Alternative Four **poor** at minimizing the exposure of Wisconsin to harmful pollutants, with the caveat of a good ranking if the source of the RECs falls in the MISO region.

Foster a Strong State Economy

The RPS set forth by Act 141 provides an opportunity for Wisconsin to strengthen its economy by expanding the statewide market for renewable electricity resources. We use two criteria to measure the economic impacts of the suggested policy alternatives. Alternatives are evaluated based on their ability to (1) minimize Wisconsin's dependence on out-of-state energy and (2) maximize the number of new in-state jobs.

Alternative One:

Purchasing Renewable Electricity from Utilities, In-State Generation

If utilities choose to increase their production of renewable electricity by utilizing resources within the state, then Wisconsin's economy would benefit. In 2005, 12.7 billion kWh of electricity were imported, making up 18 percent of the total electricity consumed within the state (WDOA, 2006, p.53). In 2005, the cost of imported electricity averaged 4.87 cents per kWh (WDOA, 2006, p. 55). Act 141 calls for state facilities to collectively consume 93.2 million kWh of electricity by the end of December 2007. We posit that this new electricity would displace the most expensive current source — imported electricity. Therefore, for every kWh increase in in-state electricity production, approximately 4.87 cents would remain in Wisconsin that would have otherwise been spent on imports. The result of this displacement would be a net decrease in Wisconsin's reliance on out-of-state providers. In this scenario, Wisconsin would increase control over its supply of energy, become less vulnerable to price volatility in the market for non-renewable electricity and reduce out-of-state expenditures. These effects illustrate the **excellent** effect Alternative One would have on minimizing Wisconsin's dependence on out-of-state energy.

Increasing the renewable electricity produced in-state would create new jobs in Wisconsin as well. Engineering, materials, construction and maintenance, among other sectors, would experience increased demand for goods and services. The magnitude of job creation has not been estimated relative to the increased renewable consumption stipulated by Act 141. Nevertheless, the entire renewable generation operation would occur in Wisconsin, so we estimate Alternative One to have an **excellent** effect on maximizing the number of new state jobs.

Alternative Two:

Purchasing Renewable Electricity from Utilities; Out-of-State Generation

If Wisconsin's utilities pursue renewable generation of their electricity outside of Wisconsin, then dependence on out-of-state energy resources does not decrease. We therefore rate Alternative Two **poor** with respect to minimizing dependence on out-of-state energy.

Similarly, retaining a Wisconsin utility to supply the electricity mildly helps the economy and likely produces a modest increase in the number of jobs, yet this number is unlikely to be significant. To the extent that jobs will be created, they will be entirely contained within the utility. Alternative Two rates **fair** with respect to maximizing the number of new state jobs.

Alternative Three: State Generated Renewable Electricity

If state facilities develop the necessary infrastructure for generating renewable electricity to meet Act 141's targets for 2007, then Alternative Three performs identically to Alternative One in terms of (1) minimizing dependence on out-of-state electricity and (2) creating jobs for Wisconsin. Thus, Alternative Three achieves a rating of **excellent** in terms of reducing Wisconsin's dependence on out-of-state energy and rates **excellent** regarding the creation of new Wisconsin jobs.

Alternative Four: Renewable Energy Certificates

Certificates would be purchased from areas where resources for generating electricity are optimal and the "green premium" is the lowest. Such locations may be distant from Wisconsin. Because of the possible divide between Wisconsin and the regions where RECs are generated, RECs would not make Wisconsin any less dependent on energy imports, and Wisconsin would continue to import the same levels of electricity. Additionally, new Wisconsin jobs would not result from the purchase of out-of-state certificates. Consequently, this alternative performs the worst of the four suggested alternatives in terms of fostering a strong state economy. Alternative Four earns a **poor** rating in the category of reducing Wisconsin's dependence on out-of-state energy and **poor** in its ability to create new Wisconsin jobs.

Maximize Feasibility

This analysis defines feasible alternatives to be those that foster the highest capability of successful implementation. Under this definition, many aspects of feasibility are contained within the other criteria in the assessment rubric. For example, the cost-effectiveness of alternatives plays a vital role in determining their palatability to policymakers. Similarly, the options that best help the natural environment are likely to engender the most support from the Wisconsin public. However, such criteria are duly analyzed in this report's sections on maximizing efficiency and promoting a healthy natural environment in Wisconsin. To minimize redundancy, this section on maximizing feasibility solely discusses the aspects of feasibility that are not analyzed in other sections of the report.

Two distinct impact categories pertain solely to feasibility. First, policy options that minimize DOA regulatory oversight costs help increase their administrative feasibility. Second, we make the assumption that political support will be greater for alternatives that have proven successful in other states. Each alternative is therefore evaluated in terms of maximizing political support based on successful adoption in other states. We utilize these two impact categories to assess each alternative's feasibility. Nonetheless, we wish to stress that an option that performs well in each of these impact categories is not necessarily feasible. This is due to the role played by other criteria within this report on overall feasibility.

Alternative One:

Purchasing Renewable Electricity from Utilities; In-State Generation

Purchasing renewable electricity from utilities that will invest in in-state resources to comply with Act 141 is an **excellent** alternative in terms of minimizing DOA's oversight costs. To maintain the mandated levels of renewably generated electricity, DOA only needs to examine state facilities' utility statements. If the mandated levels are not met, DOA can remedy the situation by working directly with the utilities to purchase more electricity from renewable resources.

Purchasing renewable electricity from utilities pursuing generation with in-state resources receives a rating of **excellent** with respect to maximizing political support based on successful implementation in other states. This option has been used by states aiming to fulfill their RPS goals as well as states that have set specific renewable electricity goals for their state agencies. For example, Minnesota encourages its utilities to increase investment in in-state renewable resources to help reach RPS goals (see Appendix E2). All five states with specific electricity goals for their state agencies purchase a portion of their renewable electricity from utilities with electricity generated in-state (see Appendices F1-F5).

Alternative Two:

Purchasing Renewable Electricity from Utilities; Out-of-State Generation

Alternative Two would perform identically to Alternative One with respect to minimizing DOA's oversight costs and is therefore rated **excellent** in this category.

Purchasing renewable electricity from utilities that will invest in out-of-state resources also receives a rating of **excellent** in terms of maximizing political support based on successful implementation in other states. The utilization of this alternative in other states is due to the variances of quantity of renewable electricity resources within specific regions of the country. Out-of-state generation is common in unregulated markets. For example, the same regional utility provides renewable electricity to Maryland and New Jersey. Since this renewable electricity flows through the regional electricity grid, a portion of the renewable electricity consumed within a given state is generated out-of-state. Wisconsin utilities currently generate renewable electricity in Iowa for use in Wisconsin (Alliant Energy, 2006, p.7).

Alternative Three: State Generated Renewable Electricity

At the opposite end of the oversight spectrum is the generation of renewable electricity by DOA — a **poor** alternative in terms of minimizing DOA regulatory oversight. Self-generation of electricity involves significant levels of oversight because under this process, DOA is responsible for working with state facilities to develop the renewable generation plants and for continually monitoring the electricity output of the plants to ensure that it reaches the mandated levels of renewable energy.

Despite the fact that a significant portion of state oversight arises from the initial phases involved in the self-generation alternative, DOA oversight of self-generating electricity stations remains significant even after the electricity plants are functioning. This is especially true when compared to DOA oversight needed in Alternative One, Two or Four. When generating electricity itself, DOA must ensure that there is regular oversight of the electricity output of the plants, whether they are run publicly or privately (refer to footnote 11).

While states and state agencies are experimenting with on-site generation of renewable electricity, we are unaware of other states that utilize this method as a primary means to satisfy their RPS or the renewable electricity goals established for state agencies. On-site generation at state facilities therefore does not have the same strong track record as Alternatives One and Two with respect to political support. We assign a rating of **poor** with respect to this impact category. Our rating is not because the alternative is politically unpalatable but instead due to the fact that it has yet to be proven politically popular.¹⁶

¹⁶ We offer the caveat of self-generation in limited implementation, specifically on University of Wisconsin System campuses. This alternative carries with it educational benefits that have positive impacts on political feasibility. Because the benefits only accrue in this limited setting

Alternative Four: Renewable Energy Certificates

A system for purchasing green certificates, with credible oversight, is already in existence, thus the burden of regulatory oversight for DOA would be minimal. As a result, purchasing green certificates receives a rating of **excellent** with respect to minimizing DOA oversight.

Purchasing RECs to meet RPS goals has a limited track record. It therefore receives a rating of **fair** with respect to maximizing political support based on successful adoption in a limited number of other states. Oregon and Minnesota are the only states of which we are aware that plan to use RECs to meet a portion of their renewable electricity targets (see Appendix F3 for Oregon and Appendix E2 for Minnesota).

Maximize Efficiency

In this section, we measure efficiency in two ways. First, we look at each alternative's ability to promote the long-term cost efficiency of renewable electricity consumed in Wisconsin. This criterion focuses on the future establishment of inexpensive renewable electricity for all Wisconsin consumers. Second, we examine the present dollar cost per kWh that DOA would expend on each alternative.¹⁷ Cost estimates per kWh are summarized in Table 5 and discussed below.

Table 5: Cost Estimates for Each Alternative

	Alternatives			
	Purchasing Renewable Electricity from Utilities; In-State Generation	Purchasing Renewable Electricity from Utilities; Out-of-State Generation	State Generated Renewable Electricity	Renewable Energy Certificates
Capital Costs	\$0	\$0	\$55 - \$65 million	\$0
Marginal Cost per kWh	1-cent premium	1- to 2-cent premium	no premium	1.5- to 2-cent premium

we do not include this impact on our assessment of how self-generation performs with respect to overall political feasibility.

¹⁷ Cost estimates are provided solely for meeting the Act 141 target for 2007. We do not offer cost estimates for the 2011 target due to expected technological advances in the renewable electricity market.

Alternative One:

Purchasing Renewable Electricity from Utilities; In-State Generation

By purchasing renewable electricity from utilities that will invest in in-state resources, DOA **excellently** promotes the long-term cost efficiency of in-state renewable electricity. With in-state generation, further research and development into renewable generation would occur in Wisconsin. The utilities would be able to use their new understanding to provide better and cheaper renewable electricity to all Wisconsin residents. Moreover, all positive externalities associated with renewable generation would accrue to Wisconsin residents. For example, any public exposure Wisconsin would gain from association with premier renewable electricity generation would be a positive externality.

Similarly, we estimate that purchasing renewable electricity from utilities that generate it in Wisconsin is the cheapest of the four alternatives, in terms of dollars expended per kWh, for DOA. This alternative is **excellent** in that we estimate it to cost roughly 1 cent per kWh above the cost of conventional electricity. Wisconsin facilities are projected to consume approximately 93.2 million kWh of renewable electricity in 2007. An additional penny per kWh would cost the state \$932,000. To compute the total annual cost of the 93.2 million kWh, we add the \$932,000 premium to the \$4.56 million cost of 93.2 million kWh of imported conventional electricity, yielding \$5.5 million.¹⁸

We derive our estimate of a 1 cent premium per kWh from a 2007 publication by We Energies — the dominant utility in Southeastern Wisconsin. We Energies generates the majority of its renewable energy in Wisconsin and has focused its recent development of renewable infrastructure within Wisconsin (Wisconsin Energy Corporation, 2007). Because of We Energies' tendency to generate renewable electricity in-state, we use it as an example of an Alternative One utility in establishing cost estimates for the future production of renewable electricity (see Appendix G for more information on We Energies).

Alternative Two:

Purchasing Renewable Electricity from Utilities; Out-of-State Generation

Purchasing renewable electricity from local utilities that will invest in out-of-state resources to meet Act 141's 2007 target would do a **good** job of promoting the long-term cost efficiency of in-state renewable electricity. This alternative is inferior to Alternative One in that Wisconsin would not retain the positive externalities associated with using in-state generators for its renewable electricity consumption. Nonetheless, Wisconsin residents would be well served having Wisconsin utilities continue to research and develop their renewable electricity production. Even if this occurs outside of Wisconsin, long-term costs paid by Wisconsin consumers would still be minimized by advances in research and technology.

¹⁸ See Appendix B for details.

With respect to minimizing the dollar cost per kWh for DOA, we estimate Alternative Two to be a **good** option. Alliant Energy and Madison Gas and Electric (MGE) — two major Wisconsin utilities — both generate considerable amounts of their renewable electricity outside of Wisconsin (Helgeson, personal communication, March 28, 2007). As of May 2007, Alliant Energy charges a 2-cent premium on renewable electricity for Wisconsin businesses, and MGE is scheduled to update its comparable program soon (Alliant Energy, 2007; MGE, 2007). Alternative Two is thus estimated to cost \$1.9 million in annual premiums. Nonetheless, with We Energies constituting roughly 50 percent of the electric market share in Wisconsin (Energy Information Administration, 2007b), we believe all other Wisconsin utilities would be forced to come close to their premium price of 1 cent per kWh if they wish to compete for DOA's electricity contract. If this is true, the true annual premium may be closer to \$932,000 than \$1.9 million. Using parallel calculations from Alternative One, the total cost of the 93.2 million kWh of renewable electricity would be between \$5.5 million and \$6.4 million.

Alternative Three: State-Generated Renewable Electricity

Unlike purchasing electricity as outlined in Alternatives One and Two, self-generated renewable electricity would merely be a **fair** way to promote the long-term cost efficiency of in-state renewable electricity. Wisconsin consumers would not directly benefit, in the form of lower future renewable electricity bills, from the research and development of renewable electricity at state facilities. While DOA surely would reap these benefits, they would not extend to the full Wisconsin population in the same way they would in Alternatives One and Two. Nevertheless, Alternative Three would result in the same positive externalities associated with in-state generation as with Alternative One.

Because of the large upfront capital costs, we assess Alternative Three **poorly** with respect to minimizing the cost to DOA. To build a sufficient quantity of renewable electricity generators to meet the 10 percent renewable electricity requirement, we estimate it would cost Wisconsin between \$55 million and \$65 million (see Appendix H). These capital costs are partially offset by the marginal costs of electricity being reduced to zero. The average cost of imported conventional electricity in Wisconsin is 4.9 cents per kWh (WDOA, 2006, p.55). Reducing the marginal costs of electricity on 93.2 million kWh would save Wisconsin \$4.56 million. As Appendix H demonstrates, it would take DOA roughly 12 years for the avoided marginal costs of electricity to outweigh the large upfront capital costs.

Alternative Four: Renewable Energy Certificates

Relative to promoting the long-term cost efficiency of in-state renewable electricity, purchasing RECs is **poor** and the worst of the four alternatives. In this scenario, the generation of renewable electricity occurs outside Wisconsin. All benefits from further development of renewables remain out-of-state, doing little to help reduce the price of renewable electricity for Wisconsin consumers.

Unlike Alternative Three, purchasing RECs does not yield positive externalities for Wisconsin, making it a poor alternative with respect to this criterion.

The direct cost to DOA for purchasing renewable electricity is perhaps easiest to calculate under this alternative. To gauge the cost of using green certificates to comply with Act 141, the state must add the cost of purchasing the green certificates for a fixed amount of electricity onto the cost of conventional electricity used. With REC premiums ranging from roughly 1.5 — 2.0 cents per kWh (America Wind Energy Association, 2004; Green Power Network, 2007), RECs would cost between \$1.4 million and \$1.9 million annually, making it a **good** alternative. In total, Alternative Four would cost between \$5.9 million and \$6.4 million for the 93.2 million kWh of renewable electricity.

Recommendation

There are four distinct policy options Wisconsin can pursue to comply with Act 141. First, Wisconsin could purchase renewable electricity from local utilities that will invest in in-state resources to meet Act 141's 2007 target. Second, Wisconsin could purchase renewable electricity from local utilities that will invest in out-of-state resources to meet Act 141's 2007 target. Third, state facilities could generate their own renewable electricity, likely through the construction of wind turbines. Fourth, DOA could purchase RECs to fulfill the 10 percent requirement. Based on our analysis of how each option performs against the selected criteria, we recommend that the state meet the Act 141 2007 target by purchasing renewable electricity from utilities that will invest in in-state renewable energy sources.

With respect to minimizing cost per kWh, generating the electricity at the state facilities themselves would be the most expensive alternative. To comply with Act 141, suitable state facilities would construct the generators and then pay public or private providers for their maintenance. Although Iowa is considering this option, it remains expensive. From a pure fiduciary perspective, then, the relevant options are purchasing the renewable electricity from utilities or purchasing RECs. Based on current pricing it appears purchasing directly from utilities would be the less expensive of the two. The magnitude of difference between purchasing from a utility and purchasing RECs is much smaller than the difference between purchasing from utilities and self-generation. Based on current advertised prices, buying from a utility that will meet Act 141's 2007 target by investing in renewable electricity generated in Wisconsin (We Energies, 2007) would be cheaper than buying from one that will meet the target by investing in out-of-state resources (Alliant Energy, 2007).

To best promote a healthy natural environment in Wisconsin, DOA may purchase renewable electricity from utilities or generate electricity on-site at state facilities. Benefits would accrue to Wisconsin irrespective of whether utilities choose to meet the Act 141 target by investing in in-state or out-of-state resources. Purchasing RECs is the worst alternative in terms of minimizing exposure to harmful pollutants unless special effort is made to seek out RECs generated in the MISO region (an effort likely involving higher costs per REC).

Similarly, RECs would be the worst alternative with respect to fostering a strong state economy, as 100 percent of the business associated with the consumption of RECs would remain outside of Wisconsin. Like the healthy environment criterion, a strong state economy is equally achieved through self-generation or purchasing from utilities that will invest in Wisconsin resources. In such a case, Wisconsin's economy is aided because all of the economic gains stay in state. When utilities invest in out-of-state generation, then most of the economic benefits stay out of state, although some business linked to the utilities is kept in the state.

All alternatives perform relatively well in terms of minimizing DOA oversight costs with the exception of self-generated renewable electricity. The true oversight costs associated with self-generation depend on how the DOA chooses to implement the policy, e.g. whether it asks individual state facilities to manage generation or chooses to centralize the entire generation procedure. Regarding political feasibility, most states currently purchase their renewable electricity directly from utilities. As a result, both of those alternatives have already proven themselves to be politically acceptable in other states. On-site generation and RECs have not been adopted as widely and therefore lack a proven track record. With respect to technical feasibility, on-site generation would be impossible to implement by the end of December 2007.

The economics and technology of renewable energy is rapidly changing, meaning that any assessment of policy alternatives such as the one performed in this report will always involve assumptions and should be revisited. Nonetheless, we recommend that Wisconsin purchase renewable electricity from utilities that will invest in in-state renewable energy sources to meet Act 141's 2007 target. In practice, it may be difficult for the state to require that utilities use in-state suppliers, but there are clear advantages to the state to the extent that utilities do so. The next most-favorable alternative is to purchase renewable energy from in-state utilities, even when they invest in out-of-state sources of renewable energy. This option is attractive in part because such out-of-state suppliers are likely to be in the same region as Wisconsin, therefore generating environmental benefits for the area. If utilities cannot fulfill the aggregate 10 percent requirement, our analysis suggests that DOA should favor RECs over self-generation of renewable energy to provide for any remaining shortage.¹⁹

¹⁹ Because of high costs, we recommend self-generation only be used for educational purposes on Wisconsin campuses. DOA should encourage the University of Wisconsin Board of Regents to utilize renewable electricity because of its positive educational impact on future development of renewable generation. However, DOA should not rely on campus-based self-generation to fulfill any remaining renewable electricity deficits after purchasing from local utilities.

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Appendix A: Regulated and Deregulated Electricity Markets

The State of Wisconsin has a regulated electric utility market. The last ten years have seen a tremendous nationwide policy debate about the merits of deregulating what has traditionally been a regulated natural monopoly, with controversy becoming so contentious that several states actually repealed, delayed, suspended or significantly extended their transition to a deregulated market (Clayton, 2006). What may get lost in the confusion, however, are the underlying facts and assumptions explaining why electric utility markets are regulated in the first place.

The electric utility market represents a typical example of a market failure for several reasons. The generation and transmission of electricity require substantial capital investments in power station and transmission line infrastructure. With this substantial investment comes substantial risk; without a high degree of confidence that customers would purchase the resultant electricity, few utilities build new or expand existing generation and transmission infrastructure. Historically, construction of infrastructure was delayed and customers who wanted electricity may not have been able to get it. To overcome this obstacle, government's response was to grant a legal monopoly to the utility requiring area residents to purchase electricity only from that utility. With a guaranteed customer base, the utility could justify the risk of the capital investment, and electricity service was provided where it otherwise might not.

In exchange for the status of legal monopoly, the utility must subjugate itself to some form of governmental regulation to prevent exorbitant profits, ensure proper utility growth over time and maintain an acceptable profit margin. In this traditional scenario, the public gained electricity service (where it might not have existed before) in addition to some certainty regarding future costs of the electricity. The utility gained the stability required to make capital investments in new infrastructure as well as the security of a stable customer base well into the future.

Although the Wisconsin electric utility market and the national electric utility market as a whole have matured since these regulatory practices were originally implemented, the state governmental body watching over the utility monopoly — the PSC — still plays a vigorous role in Wisconsin today. That being said, the maturation of the market has led some to believe that this government intervention is no longer necessary. The rolling blackouts experienced by California during the summers of 2000 and 2001, the 2003 power outage in the Northeast, and the abuses and eventual collapse of Enron serve as evidence for those who believe electric utility market regulation is still necessary and perhaps as important as ever. This debate is likely to remain unresolved for some time. What is important to consider for this report are the fundamental principles involved: Wisconsin customers can only purchase electricity from the local utility; Wisconsin utilities must provide electricity to their region of operation; the rate for the electricity is regulated by the government rather than determined by the free market.

Appendix B: Electricity Use and Emissions Calculations

This appendix pertains to the emissions calculations discussed in the body of the report in the section on environmental impacts of electricity production. Footnotes discussing calculations are more fully explained below.

Footnote 4

Electricity use in state owned buildings is presented as “thousands of Btu [British thermal units] per gross square foot per year” in *Energy Use in State Owned Facilities*. This unit is convenient for the purposes of that report because it converts coal, natural gas, electricity or any other energy source into common units and controls for changes in state facility size over time. However, this paper presents consumption of electricity in units of kWh. Thus conversion of units is necessary. State-owned buildings were said to use around 51,300 Btu per gross square foot of electricity in 2005 and state facility size was said to be about 59.6 million gross square feet (WDOA, 2007, p.4). Figuring total Btu consumption yields the following: $51,340 \text{ Btu/ft}^2 \times 59,568,300 \text{ ft}^2 = 3,058,236,522,000 \text{ Btu}$. One kWh is equivalent to 3,413 Btu. Converting Btu to kWh yields the following: $3,058,236,522,000 \text{ Btu} / (3,413 \text{ Btu/kWh}) = 896,055,236 \text{ kWh}$.

State electricity use as a percentage of overall electricity use

$$\frac{896,055,236 \text{ kWh}}{70,339,000,000 \text{ kWh}} = 0.0127$$

(state use) (total utility sales)

Footnote 8

Using 896,055 megawatt-hour (mWh) input and relying on default conversion factors (Table B-1): (Wisconsin Department of Natural Resources [WDNR], 2006)

Table B-1: State Electricity Emissions A

Output	Emission
1,659,010,886.36	Tons of carbon dioxide
7,339,586.51	Tons of sulfur dioxide
3,769,703.39	Tons of nitrogen oxide
30.38	Pounds of mercury

Footnote 15

Using 93,200 mWh input and relying on default conversion factors (Table B-2):
(WDNR, 2006)

Table B-2: State Electricity Emissions B

Output	Emission
165,900,162.91	Tons of carbon dioxide
733,954.56	Tons of sulfur dioxide
376,968.24	Tons of nitrogen oxide
3.04	Pounds of mercury

Footnote 18

For the purposes of this calculation, we use the cost of conventional electricity in Wisconsin to be 4.87 cents per kWh — the published averaged cost for imported electricity (WDOA, 2006, p.55). We set the conventional rate per kWh equal to the rate for imported conventional electricity because these units were likely the last units purchased (as they were the most expensive). As such, it is these units that would be displaced under new generation of renewable electricity. 4.87 cents per kWh x 93.2 million kWh = \$ 4.56 million. Hence, the cost of the 93.2 million kWh of conventional electricity would be roughly \$4.6 million.

Appendix C: Electricity Generation and Consumption in Wisconsin

Wisconsin utilities, cooperatives and private organizations produce electricity from hydroelectric dams, wood, biosolid waste, biogas resources, wind and solar resources. A brief review of each resource follows. Details on the potential of each resource to meet the renewable resource targets outlined in Act 141 are also provided. The renewable electricity generated and purchased in Wisconsin in 2005 is listed in Table C-1.

Table C-1: Renewable Energy Generated and Purchased in Wisconsin

Wisconsin Electricity Generation Distribution by Resource, 2005 (Millions of kWh)	
Hydro	1,829.00
Wood	187.4
Biosolid Waste	90.6
Biogas	321.3
Wind	93
Solar (Photovoltaic)	Less than 0.2
Source: WDOA, 2006, p. 69	

Hydroelectric

Hydroelectric dams convert the energy in falling water into electricity. Hydroelectric power has played a significant role in Wisconsin's RPS with 72 utility-owned sites and 50 privately owned sites (WDOA, 2006, p. 59). Electricity production from hydroelectric dams totaled 1,829 million kWh in 2005 (WDOA, 2006, p. 69). It is unlikely, however, that production of hydroelectric power will increase to aid in meeting the standards set by Act 141. Prime locations for hydroelectric generation have already been utilized. Public, environmental and recreational issues limit development opportunities for the remaining potential sites (Wisconsin Public Service Commission, 2004).

Biosolid waste

Biosolid waste (excluding wood) from commercial, municipal and industrial processes, such as waste from paper mills, was used to generate 90.6 million kWh of electricity in 2005. Wood is the source of biosolid waste most commonly used to generate electricity in Wisconsin. It alone accounted for 187.4 million kWh of electricity in 2005 (WDOA, 2006, p. 69). The relatively larger amount of electricity generated from wood is due to existing infrastructure in Wisconsin. Wisconsin has an ample supply of trees and scrap wood from industrial processes. Increasing the

amount of electricity produced from wood is a viable option. While the energy content of wood is not high enough to make meeting the standards set by Act 141 through wood alone feasible, wood can be used in combination with other resources.

Biogas

Biogas produced from Wisconsin's landfills, wastewater treatment plants and farms is collected and converted into electricity. In 2005, Wisconsin utilities produced 321.3 million kWh of electricity from biogas (WDOA, 2006, p. 69). Wisconsin has ample supplies of cow manure that can be used to generate electricity. Anaerobic digesters are utilized to generate electricity from manure and have been installed throughout Wisconsin. Installing additional anaerobic digesters provides a possible means to increase Wisconsin's generation of renewable electricity.

Wind

Wind turbines convert the kinetic energy of wind into electricity. Generation levels are determined by turbine design, air density and wind velocity. Technological advancements in turbine design have drastically reduced the price of wind power, making it competitive with coal in many areas. In 2005, Wisconsin utilities operated 55 large wind turbines in five locations across the state, while numerous residents operated small turbines. Utilities generated and sold a total of 93 million kWh of wind power in 2005, enough electricity for 10,500 average Wisconsin households (WDOA, 2006, p. 59). Wisconsin has adequate wind speeds for additional electricity generation (Focus on Energy, 2003). Fifteen wind-farms had been proposed as of August 2006, with total electricity capacity projections of 865,150 to 938,150 kW (Renew Wisconsin, 2006, p. 60).

Solar

Solar energy plays a minor role in Wisconsin's renewable energy portfolio, with utilities generating less than 200,000 kWh of electricity from photovoltaic panels in 2005 (WDOA, 2006). Wisconsin receives ample sunlight to make increasing photovoltaic electricity generation technically feasible. Equipment, however, remains expensive, making other renewable resources comparatively more appealing.

Appendix D: State Level Renewable Fuel Portfolio Requirements (RPS)

Table D-1 outlines the RPS requirements in practice in each state. Twenty-six states have RPS requirements.

Table D-1: State Level Renewable Fuel Portfolio Requirements²⁰

State	RPS Percentage and Timeline	Legal Framework of RPS	Caveats, Exceptions, and “Out Clauses”
Alabama	No explicit RPS		
Alaska	No explicit RPS		
Arizona	15% by 2025	State agency decision (2006)	30% of renewable electricity must be from distributed energy sources
Arkansas	No explicit RPS		
California	33% by 2020; 20% by 2010	Senate Bill (2002)	
Colorado	10% by 2015; phased introduction	Statute (2004)	4% of renewable electricity must be solar; 50% of solar must be located on-site at customer facility
Connecticut	14% by 2010; phased introduction	Statute (1998), Senate Bill (2006)	If don’t comply, utilities owe 5.5 cents per kWh
Delaware	10% by 2019; phased introduction	Senate Bill (2005)	Utilities with peak load more than 1,500 kWh exempt; can recover production costs through customers’ bills
Florida	No explicit RPS		
Georgia	No explicit RPS		
Hawaii	20% by 2020; phased introduction	Senate Bill (2004); replaced prior RPS goal from 2001	Public Utilities Commission can grant exemptions as it sees fit
Idaho	No explicit RPS		

²⁰ Source: DSIRE 2006, except for Minnesota, which is from Minnesota State Senate (2007).

State	RPS Percentage and Timeline	Legal Framework of RPS	Caveats, Exceptions, and “Out Clauses”
Illinois*	8% <i>goal</i> by 2013, phased introduction	Enacted by a state agency in 2005, amending a similar 2001 policy	
Indiana	Bills proposed but not passed		
Iowa**	No RPS, only policy pertains to state-facilities and is duly referenced in the case-study analysis		
Kansas	Kansas Energy Council is exploring RPS		
Kentucky	No explicit RPS		
Louisiana	No explicit RPS		
Maine	30% of all utilities (1999); increase consumption of new renewable electricity by 10% by 2017 (2006)	2006 - part statutory law; 1999 - state agency adoption	Utilities eligible to lose their license without compliance; they are obligated to report annually
Maryland**	7.5% by 2019; phased and tiered	Code of Maryland (2005)	Failure to comply results in 0.8 cents per failed kWh; suppliers can recover compliance costs from customers
Massachusetts	Increased consumption of new renewable electricity by 4% by 2009	Statute (1997), updated in 2002	
Michigan	Statewide RPS is under consideration		
Minnesota*	25% by 2025, phased introduction; 30% by 2025 for largest Utility, phased introduction	Statute (2007)	
Mississippi	No explicit RPS		
Missouri	No statewide RPS; one exists in city of Columbia		

State	RPS Percentage and Timeline	Legal Framework of RPS	Caveats, Exceptions, and “Out Clauses”
Montana	15% by 2015; phased introduction	Statute (2004)	\$10 per mWh penalty for missed goal
Nebraska	No explicit RPS		
Nevada	20% by 2015	Statute (2005)	5% of renewable electricity must be solar
New Hampshire	No explicit RPS		
New Jersey**	22.5% by 2021; 2.12% solar by 2021; phased introduction	RPS was passed by a statute (1999); solar was passed through a state agency (2006)	
New Mexico	20% by 2011; phased introduction	Statute (2004)	
New York	24% by 2013	State agency adoption	Gives exemptions to municipal utilities, the New York Power Authority and the Long Island Power Authority
North Carolina	No explicit RPS		
North Dakota	No explicit RPS		
Ohio	2006 commission recommended RPS, but it has not yet been implemented		
Oklahoma	No explicit RPS		
Oregon**	25% by 2025 with phased introduction under consideration		
Pennsylvania**	18% by 2020	Statute (2004)	Will compensate electric distribution companies for “the reasonable and prudently incurred costs of complying”
Rhode Island	16% by 2020; phased introduction	Statute (2004)	
South Carolina	No explicit RPS		
South Dakota	No explicit RPS		
Tennessee	No explicit RPS		

State	RPS Percentage and Timeline	Legal Framework of RPS	Caveats, Exceptions, and “Out Clauses”
Texas	5,800 mWh of renewable electricity by 2015	Statute (2005)	
Utah	No explicit RPS		
Vermont	Total state electric growth between 2005-2012 must be met with renewables	Statute (2005)	
Virginia	No explicit RPS		
Washington	15% by 2020; phased introduction	Ballot initiative (2006)	Only applies to utilities with 25,000 or more customers; \$50 per mWh penalty for missing the RPS percentage
West Virginia	No explicit RPS		
Wisconsin	10% by 2015; phased introduction with varying levels of requirements annually	Senate bill (2006)	
Wyoming	No explicit RPS		
* denotes a case study on a neighboring state to Wisconsin; ** denotes a case study on a state with comparable legislation to Act 141			

Appendix E: Case Studies of States Similar in Geography to Wisconsin and a Global Review of Renewable Electricity Goals

Table E-1 summarizes the cases studies of states similar in geography to Wisconsin, outlined in Appendices E1 and E2.

Table E-1: Renewable Energy Goals for Minnesota and Illinois

State	Renewable Electricity Goal: (percentage and timeline)	Legal Framework	Primary Mode of Attainment	Primary Renewable Electricity Source
Minnesota	25% by 2025; 30% by 2020 for largest electricity utility, Xcel Energy	Legislative act	Purchase from utility	Wind, biomass, hydro, solar
Illinois	State agency goals: 5% by 2010; 15% by 2020 (voluntary) State RPS: 8% by 2013 (voluntary)	Legislative act	Purchase from utility	75% from wind
Source: DSIRE, 2006				

Appendix E1: Illinois

The State of Illinois has Renewable Energy Goals (REG). A REG is like an RPS, except the targets are not mandated by law. Thus, the goals Illinois has set for state facilities and for utility companies are both voluntary. State facilities aim to obtain 5 percent of their electricity from renewable resources by 2010 and 15 percent by 2020 (Illinois Resource Development and Energy Security Act, 2001). An annual implementation schedule has not yet been created.

More specific guidance has been given to utilities. The Illinois Commerce Commission issued Resolution 05-0437, adopting Governor Rod Blagojevich’s Sustainable Energy Plan on July 19, 2005. The plan states that utilities are “expected” to reach specific goals. Commonwealth Edison and Ameren Corporation, Illinois’ two largest electric utilities, agreed to participate (Office of the Governor of Illinois, 2005). The REG calls for utilities to supply 2 percent renewable electricity by January 1, 2007, and increase their supply by 1 percent annually until reaching 8 percent in 2013. The plan states that at least 75 percent of renewable electricity should come from wind power. Acceptable sources of renewable electricity include “wind, solar thermal energy, photovoltaic cells and panels, crops grown for energy production and organic waste biomass, methane recovered from landfills, hydropower that does not involve the

construction of new dams or significant expansion of existing dams, and other such alternative sources of environmentally preferable energy” (Illinois Commerce Commission, 2005).

As of the July 2005, about one-half of 1 percent of Illinois’ electricity consumption, or 100,000 kW, came from renewable resources. The governor’s plan calls for that amount to increase to more than 3,000,000 kW by 2013 (Office of the Governor of Illinois, 2005).

Appendix E2: Minnesota

Minnesota adopted the most aggressive RPS in the country on February 22, 2007. The law requires utilities to produce 25 percent of their total electricity supply from renewable resources by the year 2025. The state’s largest electricity provider — Xcel Energy — is required to provide 30 percent of electricity from renewable resources by 2020 (Office of the Governor of Minnesota, 2007).

To eventually generate 25 percent of electricity from renewable resources by 2025, utilities are required to follow a specific schedule: 12 percent is required by 2012, 17 percent by 2020 and 25 percent by 2025. Xcel Energy has been provided with its own timeline: 15 percent by 2010, 18 percent by 2012, 25 percent by 2016 and 30 percent by 2020. Additionally, at least 25 percent of the renewable electricity Xcel Energy provides in 2020 must come from wind (Minnesota Senate File 4, 2007).

Acceptable sources of renewable electricity include wind turbines, biomass, hydroelectric with a capacity of less than 100 megawatts, hydrogen (generated from the renewable resources) and solar power (Minnesota Senate File 4, 2007). The new legislation will increase current renewable electricity levels over eight times its current levels, resulting in an additional 5 million kWh (Office of the Governor of Minnesota, 2007).

Additionally, Minnesota developed policies to aid utilities in meeting these requirements. Utilities are responsible for preparing reports detailing their current renewable electricity production levels, current efforts to increase production, the difficulties they face in achieving compliance and the potential solutions to their difficulties. Reports must be prepared at least every two years. Also, a tradable renewable energy credits program will be developed by January 1, 2008, with trading permitted between utilities within the state and between states. Meeting RPS requirements are further facilitated by utilities that are required to study and develop plans for the transmission network needed to support the renewable electricity standards. Utilities must submit a report to the Minnesota Public Utilities Commission by November 1, 2007, detailing completed analytical work, critical issues, ongoing efforts and a five-year plan identifying actions needed to implement proposals (Minnesota Senate File 4, 2007).

Appendix E3: Global Review

To gain a broader insight of possible renewable electricity consumption policies, we investigate the existence and nature of policies promoting renewably generated electricity in other countries. Robert Cramer of the Wisconsin DOA directed our attention toward Spain, Germany and Denmark, and our research generated pertinent information from an even broader sampling of countries. We draw on the work of Renewable Energy Policy Network for the 21st Century (REN21) and the World Resources Institute for much of our information. We discuss our findings generally here and point the reader to the websites of World Resources Institute and REN21 for brief yet more detailed analyses.

Only eight other countries have enacted RPS: Australia, Belgium, Italy, Japan, Poland, Sweden, Thailand and the United Kingdom. While these are the only countries with an official, national RPS, many countries have *targets* for a given percentage of their electricity to be generated from renewable fuels. More than 30 countries use a more common policy, the feed-in tariff to promote renewable power generation (REN21, 2005). Feed-in tariffs vary widely from country to country, but they essentially do two things: guarantee a renewable power generator access to the grid by requiring that the utility purchase generated electricity; establish a minimum price for a given unit of energy that the utility must pay. Countries have enacted many other types of policy to promote renewable power generation, the vast majority of which have been summarized by REN21 in a comprehensive table in its Renewables Global Status Report 2005.

Table E3-1 presents information regarding Spain, Denmark and Germany. The Spanish feed-in tariff allows renewable power generators to choose to sell their electricity to a distributor in exchange for the regulated tariff or on the open market for the market price with additional possible incentives and premiums (World Resources Institute, n.d.a). German feed-in tariff rates vary by technology and size of installation (World Resources Institute, n.d.b). The tariff rate in Denmark for wind power is 85 percent of the household electricity rate (World Resources Institute, n.d.c). The Green Power Market Development Group-Europe of the World Resources Institute has prepared excellent, brief case studies for each of these countries.

Table E3-1: Global Policies on Renewables

Policy	Spain	Germany	Denmark
Feed-in tariff	X	X	X
Capital subsidies / grants / rebates	X	X	
Investment tax credit	X	X	X
Sales tax / energy tax / value-added tax reduction		X	
Tradable renewable energy certificate			X
Net metering			X
Public loans / investments / financing	X	X	
Source: REN21, 2005, Table 4			

Appendix F: Case Studies of States with State Agency Renewable Electricity Standards

Table F-1 summarizes the cases studies of states with state agency renewable electricity standards, outlined in Appendices F1-F5.

**Table F-1: Review of States
with Renewable Electricity Standards for State Facilities**

State	Mandated State Facility (percentage and timeline)	Legal Framework	Mode of Attainment	Primary Source of Electricity
New Jersey	10%, effective immediately	Executive order	Purchase from utility	Wind; hydro
Maryland	20 % by 2015	Executive order	Purchase from utility	At least 50% from wind;
Pennsylvania	20%, effective immediately	Executive order; Legislative act	Purchase from utility	Ethanol, biodiesel
Iowa	10% by 2010	Executive order	Purchase from utility; on-site generation (proposed)	Wind; biomass
Oregon	25% by 2010; 100% by 2025	Proposed state legislation	Purchase from utility; green certificates (proposed)	Wind; biomass; photo voltaic
Wisconsin	10% by 2007 20% by 2011	Legislative act	Purchase from utility (current)	Wind
Source: DSIRE, 2006				

Appendix F1: New Jersey

In conjunction with one of the most aggressive statewide RPSs from across the country, New Jersey has a stringent requirement on renewable electric energy consumption for its state facilities (EPA, 2003). Both standards began in 1999 under Governor James McGreevey. The RPS is imposed on all utilities in the state, with the ultimate goal of having 22.5 percent of New Jersey’s electricity come from renewable resources by 2021. To accomplish this, New Jersey will phase in the standards, (4 percent in 2008) and then continue upward year by year.

Like the RPS, New Jersey’s state facility standard began in 1999 after a mandate from Governor McGreevey. Active immediately, the standard requires that 10 percent of state electricity come from “green power” sources. The New Jersey Consolidated Energy Savings Program (NJCESP) was created in 1999 to facilitate the switch to green power energy. Made up of representatives from all major state agencies, the NJCESP’s primary job is to purchase all green power for the State

of New Jersey. Given that 178 public agencies fall under the purview of NJCESP, its electricity purchases tend to be mega sales. In total, NJCESP originally planned to purchase 500 million kWh of green power over four and a half years, putting the state slightly over the 10 percent mark the governor mandated (EPA, 2003).

One of the chief characteristics of the New Jersey electricity market is that it is deregulated. As such, NJCESP was able to open up its demand for renewable electricity to the free market. In doing so, it awarded energy contracts to three main suppliers, thereby reaching its goal of 500 million kWh. The largest contract was with Pepco Energy Services, which agreed to supply nearly 200 million kWh of wind-generated electricity from July 2003 to March 2006 for an additional 0.8 cents per kWh. The second largest contract was with Conectiv Energy for 150 million kWh from various renewable resources from November 2000 to April 2002 for an additional 1.3 cents per kWh. Finally, NJCESP signed a contract with Green Mountain Energy Company, which agreed to supply roughly 130 million kWh of wind or hydro generated electricity from April 2002 to June 2003, supplied for an additional 1.1 cents per kWh.

Over and above the obvious environmental benefits reaped by New Jersey's program, several other unforeseen repercussions have transpired that are worth noting. First, the private sector has followed the example of the NJCESP and increased its purchases of green power electricity. Second, Conectiv Energy's conventional electricity prices rose dramatically during 2001, causing New Jersey to save roughly \$200,000 by purchasing renewable electricity. Third, the consolidation of electricity purchases by all 152 state agencies into one buyer — the NJCESP — has resulted in savings through substantial economies of scale.

Appendix F2: Maryland

Before Maryland enacted its RPS on all state utilities in 2005, Governor Parris Glendening issued Executive Order 01.01.2001.02 in March of 2001 calling for 6 percent of the electricity used by 18 state agencies to come from renewable energy (Sustaining Maryland's Future with Clean Power Executive Order, 2001). This renewable electricity requirement came coupled with a call to reduce total state government electricity consumption by 10 percent of its 2000 baseline in 2005 and 15 percent by 2015. To meet the renewable energy order, the state created a 16-member Green Buildings Council that would develop a High Efficiency Green Buildings Program. The Maryland Department of General Services is the agency ultimately responsible for ensuring that Maryland's state facilities meet the governor's mandate.

Like New Jersey, Maryland is also a deregulated energy market, enabling the state to post an invitation to bid for its renewable electricity contract. After multiple bids, Maryland Department of General Services awarded the contract to Pepco energy services in January 2002 (Maryland Department of General Services, 2002a). Beginning in July 2002, the contract awarded Pepco energy services \$65 million

over two years in exchange for providing 1,600 million kWh of energy, 96 million of which was from green energy sources. Pepco Energy Services' green energy was generated from wind, landfill mass, biomass or municipal solid waste.

In late 2002, Maryland upped its goal for state facility green electricity usage to 20 percent, at least half of which must be derived from wind, solar voltaic or solar thermal sources (Maryland Department of General Services, 2002b). The other half of the requisite renewable electricity could be from any source, including biomass, landfill gas, or municipal solid waste. The new electricity contracts were for 27 months, running from July 2003 to October 2005.

Appendix F3: Oregon

The State of Oregon has no statewide RPS, yet it is contemplating of legislation to mandate one of the highest RPS in the nation (Oregon Department of Energy, 2007). In 2001, the Oregon legislature mandated all authorized state agencies reduce their use of electricity from nonrenewable sources to levels that are 10 percent below their 2000 levels (Oregon Revised Statute 276.915(3)(e)). To accomplish both goals, Oregon has and continues to initiate many changes in its electricity policy.

The recommended RPS under consideration in the Oregon legislature would be among the highest in the nation. The proposal calls for 10 percent of Oregon's electricity to come from renewable energy resources by 2015 and 25 percent by 2025 (Oregon Department of Energy, 2005).

While these statewide RPS goals are ambitious, the renewable electricity goals for the state government reach even further. The proposed legislation calls for 25 percent of all state government electricity to come from renewable energy resources by 2010 and 100 percent of all state government electricity to be generated from renewable resources by 2025 (Oregon Department of Energy, 2005). Although these levels remain proposals, mandated renewable resource levels already exist for Oregon state agencies. Presently, all Oregon agencies must maintain nonrenewable electric energy consumption levels at 10 percent below their 2000 levels (Oregon Revised Statute 276.915(3)(e), 2007).

To achieve its proposed renewable electricity levels, Oregon's Action Plan recommends numerous short- and long-term goals that utilize a combination of renewable energy resources. All of these recommendations operate within the regulated structure of Oregon's electric utility system (PacifiCorp, 2007). The Action Plan calls for a variety of sources to supply the increased amount of renewable electricity, including specific quantities of new wind, biomass, geothermal and photovoltaic cells (Oregon Department of Energy, 2005).²¹

²¹ The Action Plan provides precise calculations of the amount of renewable energy that can be recovered from each new source.

The Action Plan also provides specific ideas for ways in which the State of Oregon can increase its use of renewable energy resources. One source of renewable energy is the purchase of green tags. Green tags are “coupons” that are bought to finance a renewable resource project, virtually identical to Renewable Energy Certificates. The Action Plan calculates that it would cost Oregon about \$200,000 a year in green tag fees to cover 10 percent of the state’s electricity needs. Payments such as green tags count toward renewable energy resource levels. Another potential renewable energy resource for the state is to independently enter into a “stable-price” energy contract with an alternative electric supplier, although this option is not viable at the present moment. A third option for the State of Oregon is to directly invest in on-site renewable electricity production projects. This option has the potential for significant long-term savings and would place the state government in a position of leadership within the field of energy policy (Oregon Department of Energy, 2005).

Appendix F4: Iowa

In April 2005, Iowa Governor Tom Vilsack signed Executive Order 41. Its focus is to increase the role of Iowa’s state government in energy conservation and its use of renewable energy resources. Section III of Executive Order 41 specifically addresses the possibility of increasing the use of electricity generated from renewable energy resources. In the section, Governor Vilsack mandates that 10 percent of all electricity used by state facilities come from renewable energy resources by 2010 (Iowa Executive Order 41, 2005). The order applies to all state agencies that pay for their buildings’ electricity bills.

To achieve the required levels of electricity, state agencies may generate electricity from their own renewable energy plants or may take part in their local utility’s green power purchase program (Iowa Executive Order 41, 2005, Section III). As defined by Iowa law, renewable energy resources include: solar, wind, waste management, resource recovery, refuse-derived fuel, agriculture crops or residue, hydro and wood burning (Iowa Code Section 476.42, 2005).

Although Executive Order 41 was signed in 2005, Iowa has long been working to develop its renewable energy resources. Given its physical location and its large agriculture-based economy, the renewable resources with the largest electricity generation potentials in Iowa are wind and biomass.

Iowa is the nation’s tenth windiest state (Iowa Department of Natural Resources, 2002). As a result, electricity derived from wind power is the fastest growing source of renewable energy and the largest share of renewable electricity in Iowa. Between 2002 and 2003, three wind projects alone increased the electricity generated from wind sources by about 150,000 kW. During this time, MidAmerica Energy announced plans to build a 310,000 kW wind-farm (Iowa Department of Natural Resources, 2004). Due to its widespread availability in Iowa, electricity generated from wind sources has huge potential: Iowa Department of Natural Resources’ studies show that wind has the

potential to provide almost five times the amount of electricity consumed by the state each year (Iowa Department of Natural Resources, 2002).

Although biomass does not play as large a role in the generation of electricity as wind, its role is significant due to Iowa's large agriculture sector. As such, Iowa has become a world leader in the development of biomass as a renewable electricity resource. While biomass makes up a small percent of Iowa's electricity generation, it has the potential to supply 410 percent of the state's electricity needs. The leading sources of biomass energy in Iowa are crop sources (either specifically grown as fuel or crop residue) and methane recovery (Iowa Department of Natural Resources, 2002).

Appendix F5: Pennsylvania

Pennsylvania's efficiency and renewable energy standards were initially established as a result of 2004 Pennsylvania Act 213 (Pennsylvania Act 213, 2004). Introduced and passed in the 2004 session of the Pennsylvania Assembly, the act codifies the RPS for the state and sets the percentage of electricity that state agencies must generate through alternative resources. In 2006, Pennsylvania Governor Edward Rendell called on Pennsylvania residents and businesses alike to increase their environmental efforts. In an effort to lead by example, the governor doubled the mandated percentage of electricity that the state must generate from renewable resources.

As a result of state legislation from 2004, Pennsylvania state agencies are required to generate 10 percent of their electricity needs from alternative resources (Pennsylvania Act 213, 2004). Moreover, at the end of August 2006, Governor Rendell announced a doubling of these levels. The new 20 percent levels went into effect immediately. At the time of the announcement, no state imposed higher levels of electricity generation from alternative sources on its state agencies than those imposed by Pennsylvania (PA PowerPort, 2006).

Governor Rendell's move is one piece of the larger state Independent Energy Strategy introduced in 2007. Generally, Governor Rendell aims to accomplish three goals with his strategy: (1) save consumers \$10 billion in electricity costs over the next ten years; (2) encourage state fuel self-sufficiency by encouraging Pennsylvania to produce its own fuel; and (3) increase employment levels as a result of the new energy technologies and initiatives that are in production throughout the state. To accomplish the wide breadth of these goals, the state is investing heavily in increasing both the development and use of alternative electricity sources. (Office of Governor, Commonwealth of Pennsylvania, 2007).

The governor recognizes such environmental efforts affect other social issues. For example, Pennsylvania relies on coal for energy and employment. To this end, Pennsylvania is successful in attracting many of the world's leading companies doing alternative energy research and development. In the first half of this decade, more than \$24 billion has been invested into new energy projects in Pennsylvania.

Although these statistics seem impressive, “alternative energy” is defined differently in Pennsylvania statutes than elsewhere. Under Pennsylvania law, alternative energy sources can include coal mine methane gas and waste coal. To produce and use these energy sources, coal must first be used as an energy source. As a result, the environmental effects from these energy sources are not as great as the effects from using renewable electricity sources such as solar or wind power. It is for this reason that Pennsylvania statutes specifically label their non-traditional electricity sources “alternative” sources rather than “renewable” or “green” sources.

Appendix G: Technical Feasibility

Technical feasibility refers to the physical ability to produce the renewable electricity required by Act 141 by December 31, 2007. Alternative One and Alternative Two — purchasing from utilities investing in in-state and out-of-state resources to supply the electricity needed for the Act 141 target — are evaluated together. Alternative Three and Alternative Four are discussed individually.

Technical Feasibility: Alternatives One and Two — Purchasing from Utilities

The scale of renewable electricity generated by We Energies and Alliant Energy in 2005 makes the amount the state must purchase in order to comply with Act 141 seem reasonable. Wisconsin utilities commonly generate renewable electricity at both in-state and out-of-state locations. In terms of meeting Act 141 targets, the location of renewable generation is inconsequential. Additionally, DOA may divide contracts among providers, increasing the availability of renewable electricity.

One of Wisconsin's largest renewable electricity providers is We Energies. In 2005, We Energies total renewable energy generation was between 650 million and 700 million kWh (Wisconsin Energy Corporation, 2005, p.75). We Energies' Energy for Tomorrow program offers 100 percent renewable electricity for a 1 cent per kWh premium for any consumer needing more than 70,000 kWh of renewable electricity per month. Wisconsin state facilities use roughly 75 million kWh of electricity per month and need approximately 7.5 million kWh of renewable electricity per month to meet Act 141's target for 2007. The state would therefore have no difficulty in meeting We Energies' minimum consumption level. We Energies' advertisements imply it is eager to provide for large customers, leading to our belief that it could supply a large portion of the needed renewable electricity. Pat Keily, a representative of We Energies, explained that the electricity for Energy for Tomorrow comes from two landfill facilities, three hydroelectric facilities and two wind-farms, all in-state, and one out-of-state wind-farm (2007).

Mr. Keily offered a rough approximation of 70 million kWh for the total electricity sold in the Energy for Tomorrow program in 2006. He suggested that We Energies could roughly double that amount without having to seek out additional sources of generation (2007). He also said that We Energies has done "back of the envelope calculations" and figured that it could provide state facilities in their service territory with 10 percent renewable electricity from the Energy for Tomorrow program without needing more sources of generation (2007).

Alliant Energy is a major provider of renewable electricity generated out-of-state. Across its four-state service territory, in 2005 Alliant generated approximately 880 million kWh of electricity from wind alone. In that same year Alliant sold more than 40 million kWh of renewable electricity through its Second Nature program (Alliant Energy, 2006, p.7).

The quantity of renewable electricity that utilities will make available for purchase by the State of Wisconsin at the end of December 2007 will not be known until contracts have been negotiated and approved. However, we believe the information presented above suggests that purchasing renewable electricity from utilities will be a technically feasible means to meet Act 141's 2007 target.²²

Technical Feasibility: Alternative Three — State Generated Renewable Electricity

Cielo Wind Power (2005), the largest wind developer in the Southwest United States, the National Wind Coordinating Committee (2002, p.8), and Florida Power and Light (2007) offer timeframe estimates of the entire wind-farm construction process. They estimate that a minimum of a year is required from the time permits are submitted until electricity is actually generated. Additionally, We Energies projects that its newest wind-farm will take approximately a year to complete (Wisconsin Energy Corporation, 2007). Given the December 31, 2007 deadline faced by DOA, developing the needed infrastructure to generate renewable electricity from wind is not technically feasible.²³

Technical Feasibility: Alternative Four — Renewable Energy Certificates

Mike Forese, a representative for NewWind Energy, characterized the size of the REC purchase that the state would make to fulfill Act 141 as “reasonable” and on par with other large government, university, and business purchases (2007). He stated that, allowing for negotiations and other transaction requirements, the state would certainly be able to purchase enough RECs from the national market, but would find less availability if it wanted to purchase from a regional market.

²² We suggest that purchasing renewable electricity from utilities will likely also be a technically feasible means to meet Act 141's 2011 target due to current expansions in infrastructure (see Appendix C for more information on proposed new wind-farms in Wisconsin).

²³ On-site generation would provide the State of Wisconsin with a technically feasible means to reach targets set by Act 141 for 2011.

Appendix H: Self-Generated Renewable Electricity Capital Costs

We estimate Wisconsin would need to pay roughly \$59.7 million in capital costs to finance the required amount of generation needed to supply renewable electricity to state facilities. We choose to predict the cost of utilizing wind as the renewable resource because of its relatively low cost compared to other renewables and abundance in Wisconsin.

To arrive at this estimate, we utilize the amount of renewable electricity required to meet Act 141 requirements as calculated in Appendix B: 93.2 million kWh. With this amount, we rely on the methodology provided to us by Dr. Richard Shaten, academic coordinator of the Energy Analysis and Policy Certificate Program in the Nelson Institute for Environmental Studies, University of Wisconsin-Madison. This methodology is as follows:

$$\begin{aligned} \text{Amount of power needed (kW)} \times \text{Capacity factor} \times \text{availability factor (hours)} \\ = \text{Energy provided (kWh)} \end{aligned}$$

In this case we are solving for the amount of power needed, this is our unknown. Capacity factor is a complex coefficient reflecting quality and quantity of wind, and Dr. Shaten provided a conservative statewide estimate of 0.28. Availability Factor is based on the percentage of time that a turbine is available for generation, calculated using the number of hours in one year. The American Wind Energy Association states that modern wind turbines availability factors exceed 98 percent (2007). Thus: $0.98 \times 365 \times 24 = 8,585$. Again, we utilize the 93.2 million kWh from Appendix B for the amount of energy needed.

$$\begin{aligned} \alpha \text{ (kW)} \times 0.28 \times 8,584 \text{ (hours)} &= 93,200,000 \text{ (kWh)} \\ \alpha &= 38,772.8 \end{aligned}$$

Solving for α yields 38,772.8 kW. Assuming this electricity is fed into the grid before actually being consumed, we must take into account transmission loss, estimated conservatively at 20 percent by Dr. Shaten. Dividing 38,772.8 by $(1 - 0.2)$, we estimate the state would need approximately 48,470 kW worth of wind generating capacity. A recent study by the University of Illinois posits that it costs \$1,231 per kW to construct wind turbines (Bournakis et. al., 2005, p.50). Accordingly, our estimate for capital costs is $48,470 \times 1,231 = \$59.7$ million.

To better gauge the relative size of the capital cost estimate, it is beneficial to understand how long it would take DOA to recoup its investment. With a 2 percent annual increase in electricity consumption in Wisconsin and an annual discount rate of 3 percent in line with other state rates (Wisconsin Division of Energy, 2007, p.15), we conclude that it would take DOA 12 years before its avoided electricity costs would outweigh the capital costs necessary to construct the wind turbines. We conservatively assume the avoided electricity costs would

remain at 5.87 cents per kWh in the future.²⁴ Summing the present values of annual future electricity costs demonstrates that it is not until the 12th year that the avoided electricity costs surpass \$59.7 million. Table H-1 illustrates these calculations.

Table H-1: Capital Costs Versus Avoided Electricity Costs Over Time

	Renewable Kilowatt Hours Needed to Fulfill 10 Percent Requirement	Total Cost	Present Value of Total Cost	Sum of Present Value of Total Costs
Year 1	95,064,000	\$5,580,257	\$5,417,725	\$5,417,725
Year 2	96,965,280	\$5,691,862	\$5,365,126	\$10,782,851
Year 3	98,904,586	\$5,805,699	\$5,313,037	\$16,095,888
Year 4	100,882,677	\$5,921,813	\$5,261,454	\$21,357,342
Year 5	102,900,331	\$6,040,249	\$5,210,372	\$26,567,715
Year 6	104,958,337	\$6,161,054	\$5,159,786	\$31,727,501
Year 7	107,057,504	\$6,284,275	\$5,109,691	\$36,837,192
Year 8	109,198,654	\$6,409,961	\$5,060,082	\$41,897,274
Year 9	111,382,627	\$6,538,160	\$5,010,955	\$46,908,229
Year 10	113,610,280	\$6,668,923	\$4,962,305	\$51,870,535
Year 11	115,882,486	\$6,802,302	\$4,914,128	\$56,784,662
Year 12	118,200,135	\$6,938,348	\$4,866,418	\$61,651,080

We wish to emphasize that Table H-1’s calculations do not include any additional costs associated with self-generation, e.g. design, operation, maintenance or upkeep. The 12-year estimate purely demonstrates how long it would take for the avoided future electricity costs to outweigh the capital costs necessary to build the generators.

²⁴ 5.87 cents equals the minimum 1 cent per kWh premium for renewable electricity under Alternative One plus the current cost of 4.87 cents per kWh Wisconsin pays for imported conventional electricity (WDOA, 2005, p.55). We set the conventional rate per kWh equal to the rate for imported conventional electricity because these units were likely the last units purchased (as they were the most expensive). As such, it is these units that would be displaced under Alternative Three’s self-generation of renewable electricity.