POLICY APPROACHES TO SUPPORT DISTRIBUTED RENEWABLE ENERGY: BEST PRACTICES AMONG U.S. STATES

FINAL REPORT

A Renewable Energy Applications for Delaware Yearly (READY) Project

Center for Energy and Environmental Policy

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Mailing Address:

John Byrne
Director
Center for Energy and Environmental Policy
University of Delaware
Newark, DE 19716-7381

Email: jbbyrne@udel.edu
Telephone: (302) 831-8405
Telefax: (302) 831-3098
Website: http://ceep.udel.edu

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Center for Energy and Environmental Policy

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Project Team
Peter Olmsted, Research Assistant, CEEP
Matt Stern, Research Assistant, CEEP
Jinmi Kim, Research Assistant, CEEP
Hui Li, Research Assistant, CEEP

Project Advisors
Kristen Hughes, Policy Fellow, CEEP
John Byrne, Director, CEEP

Center for Energy and Environmental Policy
College of Engineering
University of Delaware

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Table of Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

This report, in support of the Renewable Energy Applications for Delaware Yearly (READY) project for 2010, reviews best practices among U.S. state governments in the area of distributed renewable energy generation. The report spotlights considerations that may be of interest for Delaware policymakers, in weighing the various options that currently characterize the field.

Through a series of aggressive legislative actions over the past several years, the State of Delaware is positioned as a clear leader in sustainable energy policy. Coupled with forward thinking environmental and climate policies, the State's leaders have taken an active role in developing the necessary tools to address the 21st century energy challenges. Coinciding with the Obama Administration taking a proactive role on many energy and environmental issues, various stakeholders are eager to build upon the momentum that Delaware has already generated.

The Renewable Energy Portfolio Standards (RPS) and Energy Efficiency Resource Standards (EERS) are key elements of a sustainable energy policy in Delaware law. The RPS requires electric suppliers to substantially increase the percentage of renewable energy generation in Delaware over the next fifteen years. Similarly, the EERS requires utilities to substantially reduce overall electricity and natural gas consumption across all customer classes over the next five years (DSIRE, 2010a; DEO, 2010). In consideration of Delaware's significant targets for reducing greenhouse gas emissions, these policies will be vital tools for reaching these goals.

Like a number of other states, Delaware has included into its RPS a solar photovoltaic (PV) carve-out, which requires this renewable technology to fulfill a growing share of the overall RPS goal. With emerging markets for Renewable Energy Credits (RECs) and Solar Renewable Energy Credits (SRECs), Delaware's RPS sets the stage for a variety of approaches to renewable energy deployment.

With these energy policies, Delaware has equipped itself with effective tools to bolster the penetration of customer-sited, distributed renewable energy applications. In the spring of 2009, during the Delaware State Senate's 145th General Assembly, Senator Harris McDowell and Representative D.E. Williams introduced Senate Bill (SB) 119. Signed into law by Gov. Jack Markell in July 2010, the resulting legislation entailed significant amendments to the state's RPS. The intent was not only to increase the RPS to 25% by 2025, but also to establish a Distributed Renewable Energy carve-out, which by that same year would require 3.5% solar PV (State of Delaware, 2010; DSIRE, 2010a). The bill defined these resources as customer-sited generation, including the following technologies:

- Solar PV or Solar Thermal
- Wind
- Ocean Energy (wave, tidal, currents, thermal difference)
- Geothermal
- Fuel Cells (powered by renewables)

- Anaerobic Digestion
- Hydroelectric < 30 megawatts (MW)
- Biomass

In addition to Delaware, many states are currently pursuing policies that support distributed renewable energy generation. Noteworthy actors are Massachusetts, Colorado, Nevada, Arizona and New Jersey. In their design and scope of impact, some state approaches may have relevance to Delaware, as it moves ahead with efforts to cultivate a more sustainable energy supply. These considerations are summarized below.

As a flexible mechanism to assist actors in meeting RPS requirements, the alternative compliance payment (ACP) is emerging as a significant component to the overall effectiveness of market-based support for the development of renewable energy. However, care must be taken to identify ACP price points that appropriately address given market conditions, achieving a level that is sufficient to stimulate investment in the sector while simultaneously shielding ratepayers from undue costs. In addition, the establishment of technology-specific ACPs may benefit from the complementary design of capacity-specific ACPs, in order to effectively incentivize investment in smaller-scale renewable energy systems. Such systems have tended to lack the economies of scale that have historically attracted investor interest.

Meanwhile, the use of renewable energy credits (RECs) continues to rely on robust market exchanges. As states appear to be opting for a regional approach, in certain cases moving away from in-state tracking systems, the need for relatively transparent and well-administered market rules takes on even greater urgency. Similarly, as the carve-out mechanism is increasingly utilized as a part of RPS policies, effective program design can help ensure a range of opportunities for distributed technologies to contribute to energy supply. A tailored orientation to customer needs, as augmented by financial support or assistance in the form of utility incentives, for example, complemented by adequate penalties for electricity suppliers that do not fulfill solar RPS requirements, can boost the impact of technology carve-outs as a significant force for distributed energy installations.

Also of importance in a number of states is the growing use of multipliers, as a means of achieving broader renewable energy goals. Multipliers may be designed to add value to the use of a particular technology based on the resource or application utilized, a project's location, or its use of technologies derived from in-state manufacturing or installed with in-state labor. The design of multipliers, however, may benefit from significant attention to the interactions (intended or unintended) that may occur as a result of their implementation. The goal is to avoid undercutting the effectiveness of the RPS in terms of the actual amount of green energy that is produced or delivered into given markets. In this regard, coordination between activities over time is a key consideration, with multiplier creation coinciding with a revisiting of RPS goals. This extra step can ensure that the latter's continued effectiveness is unimpeded.

A further concern rests upon ensuring that policy goals for distributed renewable energy are linked to efforts for research and development, demonstration and commercialization, and new manufacturing opportunities. As part of this process, the role of multi-sectoral targets, key stakeholders, timelines for action, and frameworks for leveraging resources – from local to state levels – all point to the need for robust institutional support in both the public and private sectors. This comprehensive approach can identify outstanding stakeholder needs, target action to the most critical venues, and expedite gains that may otherwise take several years to unfold, addressing both political and pragmatic barriers to new distributed renewable energy development.

1.0 INTRODUCTION

The electricity sector is under increasing pressure by various stakeholders to provide energy products and services that are clean, efficient, and reliable while simultaneously contributing to the economic security of households, businesses, and government. Federal, state, and local governments have responded to this pressure by implementing laws and policies to reduce negative environmental impacts, both traditional pollutants as well as greenhouse gas emissions. A prominent policy response has been to spur the development of the market for renewable energy resources using a renewable energy portfolio standard mechanism. Because of the unique benefits that distributed generation can provide to the conventional energy system, more states have included specific provisions for distributed generation in their renewable energy portfolio standards in recent years. This report examines and identifies best practices in the state policies to support distributed generation.

2.0 CHALLENGES ASSOCIATED WITH THE CONVENTIONAL ENERGY SYSTEM

In the U.S., more than 85% of total electricity generation is derived from coal-fired, natural gas-fired, or nuclear power plants (U.S. Department of Energy, 2010). As approximately 70% of electric generation is derived from fossil fuels, the term "conventional energy system" refers to this fossil-fueled dependent and centralized form of supplying electrical energy to end users. The following sections summarize some of the challenges associated with the conventional energy system.

2.1 Environmental

The consumption of fossil fuels has dramatically increased since the start of the Industrial Revolution. Accumulated greenhouse gas emissions (GHG) in the atmosphere have risen from about 280 parts per million (ppm) in the pre-Industrial age, to a current level of 379 ppm (Rogner et al., 2007). The need for policymakers to grapple with society's intensive use of fossil fuels is based in part on the growing body of scientific evidence which finds "anthropogenic interference" in current climactic trends (Rogner et al., 2007).

The impacts of climate change on the ecosystem and human society are expected to be highly significant (Intergovernmental Panel on Climate Change [IPCC], 2007a). These threats include severe weather events such as heat waves, drought and flooding, or damage to land through salination. Together, these phenomena can threaten food security for millions of people, resulting in malnutrition and mortality. Human health also may be threatened by the growing spread of diseases such as malaria, while rising sea levels and changing water temperatures may not only impact human habitats and livelihoods, but also contribute to ecosystem alteration and the influx of new (non-native) animal and plant species. These impacts entail a huge cost to human life and livelihoods, and threaten the economic stability of nations and the future path of development (IPCC, 2007a). To minimize the costs and risks linked to the threat of climate change, a growing number of countries have sought – individually and collectively – to make efforts to stabilize GHG emissions through an increase in energy efficiency and a shift to renewable energy. These efforts are aided by international treaties (e.g., the Kyoto Protocol), national and more local policy change, and technology-related improvements in a number of sectors (IPCC, 2007a, 2007b).

2.2 Economic

The conventional energy system presents significant challenges from an economic standpoint. Economic institutions have largely failed to capture the direct and indirect costs associated with conventional energy activities. Without adequately accounting for social and environmental costs, consumers and market participants may remain uninformed, unmotivated, or unable to respond to the true costs of the conventional energy system. Analytic tools, such as integrated resource planning by electric and gas utilities, that offer a framework to internalize the external costs of energy production have nonetheless mostly failed to account for these costs in practice and conventional energy resources have maintained a dominant position in the energy marketplace. The conventional approach for analyzing the costs and benefits of energy production and consumption have thereby created biased assessments for determining and selecting socially optimal energy resource portfolios (Roth and Ambs, 2004). In many respects, the conventional energy system has evolved into a supply-side, commodity-oriented industry in which shorter-term economic efficiency is prioritized over addressing the many externalities of energy service, including longer-term social and environmental costs (Byrne and Mun, 2003).

2.3 Energy Price Volatility

Electricity generated from conventional resources such as coal and natural gas are perceived to be cheaper than electricity derived from certain renewable resources such as solar panels, when considering only upfront costs under a traditional cost-benefit analysis (Zweibel, 2010). However, the volatility of fuel prices leads to great uncertainty with regard to conventional power generation. The price of natural gas, for example, is affected by many factors including weather conditions impacting gas consumers, storage capacity, international price trends, and natural phenomena such as hurricanes in the Gulf of Mexico, which have disrupted natural gas production. Although these factors sometimes only cause short-term increases in natural gas prices, temporary price spikes can produce higher annual operation costs for gas-fied power plants (Henning et al., 2003). Both utilities and consumers can be affected by this volatility risk.

2.4 Equity Issues

The disparate impacts of conventional electricity generation are widely known. Localized pollution severely impacts communities in the vicinity of power plants. Such communities are often low-income, minority populations (Clean Air Task Force , 2002; Hoerner and Robinson, 2008). More broadly, electricity is one of the largest contributors of the greenhouse gases responsible for global warming. The effects of climate change from global warming will most likely result in significant (and perhaps enduring) impacts for a range of groups, in particular, the most vulnerable communities both in the U.S. and abroad (Shonkoff et al., 2009; Adams and Luchsinger, 2009). Equity considerations related to energy policy and planning thus entail income, geographic, and time dimensions.

3.0 OVERVIEW OF RENEWABLE ENERGY PORTFOLIO STANDARD MECHANISMS

To address the challenges of the conventional energy system, states have developed various policies to increase the use of renewable energy. Increasing the use renewable energy by electric utilities can help the state diversify energy resources, reduce environmental impacts from GHG emissions, and achieve economic benefits such as new jobs for state residents.

Renewable energy resources provide a small but growing share of the total electricity supply. One of the reasons that the use of renewable energy has been growing is the adoption of renewable portfolio standard (RPS) policies by 29 states in addition to Washington, DC and Puerto Rico (DSIRE, 2010b). The RPS mechanism has been a successful policy in expanding the capacity and use of renewable energy resources in many U.S. states. The proportion of renewable energy consumed in Texas, for example, against larger conventional energy sources, has increased significantly from just 0.6% in 2001 to 2.3% in 2007 (Hurlbut, 2008). Since its RPS was launched in 2002, Texas has expanded its renewable energy capacity by 5.5 GW, with net generation from alternative energy resources growing by 1 TWh each year. Renewable electricity now represents almost 5% of net electricity generation in Texas (EIA, 2010). In the case of Iowa, following its implementation of an RPS, the proportion of electricity generation derived from fossil fuels has dropped by about 0.7% each year. Generation from clean sources jumped to 2.9 TWh in 2007 from 567 GWh in 2001. In Minnesota, the share of renewable energy is increasing approximately 0.5% per year, with electricity from renewable sources at 5.9% in 2007 (Hurlbut, 2008).

Overall, the structure of a RPS – under ideal conditions – should be designed to increase the attractiveness of investing in renewable energy. This structure should include methods to quantitify renewable energy development, schedules for understanding the timing of compliance requirements, supplemental mechanisms to provide flexibility for actors in meeting compliance when encountering high market prices, coordination with other energy policies, cost-recovery mechanisms, penalty mechanisms for non-compliance, and/or credit mutipliers for the use of special technologies (EPA, 2009a).

3.1 Basic Elements of a RPS Mechanism

The essential element of a RPS policy mechanism is the requirement that a certain proportion of a utility or retail electric supplier's total electricity supply be derived from renewable resources, such as wind, geothermal, solar, and biomass resources. Generally, minimum requirements for renewable energy increase each year in a step-up or ramp-up fashion to achieve an overall goal by a certain year. Most RPS policies are applicable to investor-owned utilities and competitive retail suppliers, but some states also require rural electric cooperatives and municipal utilites to meet RPS targets.

3.1.1 Tradable Certificates

The RPS is a market-based mechanism where the medium of exchange or tradable instrument is the renewable energy credit (REC). RECs represent the environmental, social and other nonpower qualities of electricity generated from renewable energy sources (EPA, 2009b). These attributes can be sold separately from the actual electricity that is generated, becoming "unbundled." Once separated, the physical energy is no longer considered to be renewable. A REC is equivalent to 1,000 kilowatt-hours (kWh) or 1 megawatt-hour (MWh) of electricity (EPA, 2009b). For RPS compliance, one REC is created from one MWh of electricity generation from state-certified renewable energy resources. RECs can also be sold in a voluntary REC market where private companies and institutions (e.g., universities and governments) buy RECs to offset greenhouse gas emissions or support renewable energy because of a commitment to renewable energy and/or to project a public image of concern for the environment.

Most states limit the time a REC can be viable after it is initially generated, generally 1 to 3 years. The renewable energy generator sells RECs to a utility/electric supplier that is required to purchase a certain number of RECs each year. The utilities/electric suppliers use or retire RECs to demonstrate compliance with the RPS.

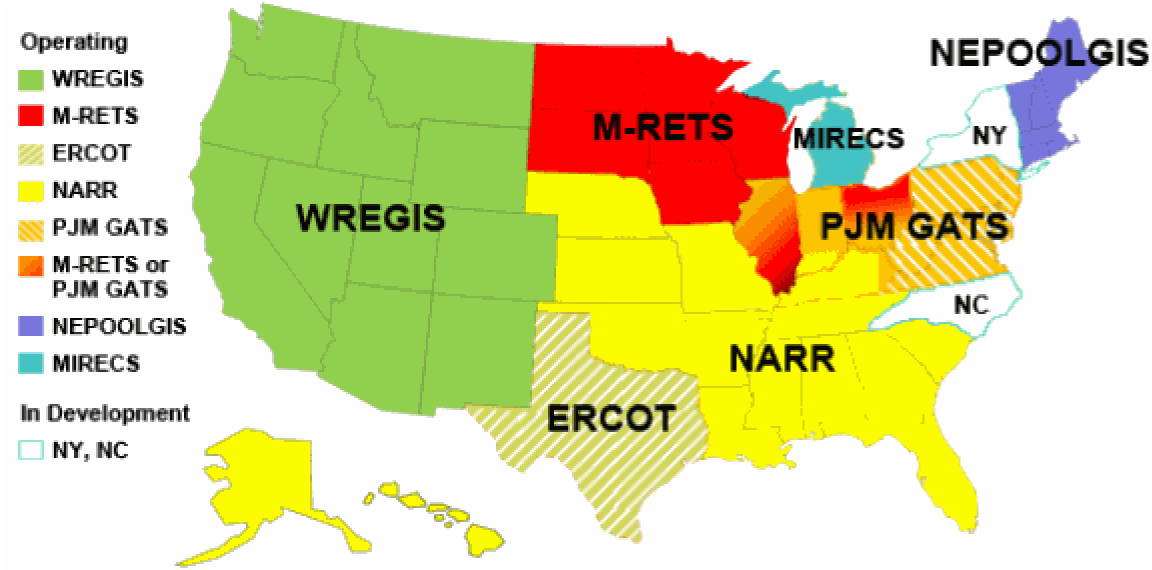
3.1.2 REC Tracking Systems

Tracking systems are designed to track and document the generation and retirement of RECs. Tracking of RECs is essential because without proper verification and tracking, double-counting disputes over ownership as well as fraudulent practices could occur. A number of regional and state certificate tracking systems have been created to follow RECs from their point of creation to their point of use (see Figure 1 below). All tracking systems have a number of similar characteristics:

- Tracking systems are essentially electronic databases that track the ownership of RECs.
- RECs are created to fulfil a RPS goal or sold in a voluntary REC market.
- Each MWh of electricity generated is issued a uniquely-numbered certificate.
- A certificate is tracked as the REC is traded and ultimately retired.
- RECs are used or retired when a claim is made on behalf of the attributes of the REC or the REC is used for compliance with a law or regulation such as a RPS.

States have the authority to determine which resources are eligible for RPS compliance. Trading areas differ between states and often correspond to the boundary area of associated REC tracking systems.

Figure 1. Regional and State Certificate Tracking Systems



Source: EPA, 2010b

3.1.3 Alternative Compliance Payments

The use of alternative compliance payments (ACPs) has been adopted as part of many RPS mandates as an alternative mechanism for demonstrating RPS compliance (Wiser and Barbose, 2008). Rather than having to secure the requisite amount of RECs and/or renewable generation, these entities are granted the ability to pay an ACP (typically 1 ACP = 1 MWh = 1 REC) as an alternative. Funds collected through the ACP mechanism are usually held in a state administered fund to support renewable energy development within the state. Use of an ACP mechanism avoids the burden of enforcement actions resulting from failure to comply with RPS provisions and provides flexibility in RPS compliance.

The ACP can also serve as a price cap for the value of RECs that are openly traded on a state or regional REC market. Accordingly, states have developed a variety of innovations to ensure that the ACP is appropriately structured over time to advance a robust and effective marketplace for REC trading. Establishing a price cap through the ACP also provides some security to ratepayers, assuring that the costs associated with RPS compliance are kept reasonable. While some states allow ACP costs to be recovered through rates, others have choosen to prohibit this practice.

3.1.4 Technology Carve-Outs within RPSs

The following list contains renewable energy technologies that are eligible for most RPS mechanisms:

- Wind
- Solar including solar thermal or photovoltaic (PV) cells
- Hydropower
- Ocean, tidal, wave

- Geothermal
- Landfill gas (methane)
- Biomass from animal or crop waste

However, eligible resources are pursued in varying ways by the states, in deference to the availability of particular resources in a state or region. For example, hydropower is not included in some state RPS policies and other states only allow small hydro, usually defined as less than 30 or 100 MW (Union of Concerned Scientists [UCS], 2010).

Some states have adopted policies to discourage overreliance on one renewable technology, require the use of various types of renewable energy technologies, or require the use of particular renewable energy technologies that have important economic benefits for the state. For example, the New Jersey RPS – which requires 22.5% total renewable energy by 2021 – distinguishes eligible resources and technologies by tier. Class I renewables, originally intended to provide 17.88% of the RPS total, include wind, solar electric, wave or tidal energy, geothermal, landfill gas, anaerobic digestion, fuel cells using renewable fuels, and certified biomass. Class II renewables, originally set to provide 2.5% of the RPS total, include hydropower smaller than 30 MW and resource-recovery facilities (DSIRE, 2010c). A specific solar set-aside was originally targeted to provide 2.12% of the RPS total, although this target has subsequently been converted from a percentage-based target to a GWh target (i.e., minimum 2,518 GWh by 2021) (DSIRE, 2010c).

States also use the ACP as an alternative for specific technology carve-outs. Most notably, a solar-based ACP (SACP) has been adopted by several states. By incorporating technology-specific ACPs, states provide further market structure and support for the development of specific renewable energy industries. States have developed a wide range of structural components for establishing technology-specific ACPs and mechanisms for adjusting ACPs over time.

3.1.5 RPS Multipliers

As an alternative to a carve-out or set aside, a handful of states have utilized a multiplier technique to incentivize paricular types of eligible technologies under the RPS. Typically structured on a "per-REC" basis, additional credit is awarded for each REC generated from a particular technology, application, or project location (Wiser and Barbose, 2008). In addition, states will commonly establish a "sunset" date after which the multipier is no longer in effect. The sunset date technique is established to incentivize the rapid deployment of particular technologies during the early years of the RPS compliance schedule. Typically, multipliers are established to provide differential support for technologies (e.g., solar photovoltaic) that face challenges in penetrating the market due to higher costs, or that have been prioritized for development due to their associated social or technological advantages.

Multipliers serve to increase the value and attractiveness of the RECs, associated with technologies eligible for multipliers, to the utilities/electric suppliers that are responsible for compliance. For example, a multiplier of 2 complaince RECs for each REC purchased by a utility is equivalent to a 2 for 1 sale at a store (if the ACP associated with the technology is not adjusted). Multipliers may reduce the cost of compliance by the reducing the total number of RECs needed to be purchased by the utility/electric supplier. On the other hand, multipliers serve to reduce the amount of renewable energy generation required by the RPS. For example, if a utility that is required to purchase 1000 RECs to meet its RPS obligations for a particular year, purchases RECs with a 2x multiplier, then the RPS that year is only yielding 500 MWh of renewable energy generation for year. Multipliers also produce a more volatile REC market for sellers as the number of RECs purchased by a utility is much less predictable if multipliers are in use.

In addition to technology multipliers, a few states have established "supporting" multipliers, which increase the value of energy generated according to criteria related to certain economic/industry goals. The goals may be to support the renewables industry or to strengthen particular aspects of the industry. For instance, some states have used the multiplier technique to incentivize the use of renewable technologies that are derived from in-state manufacturing or installed using in-state labor.

3.1.6 Long-Term REC Contracts

Financiers look for investment with relatively low uncertainty and risk. For example, energy generation projects boasting long-term purchasing contracts with electric utilities are usually deemed more creditworthy than comparable projects without such contracts (Cory and Swezey, 2007a). Renewable energy projects are often very capital intensive and investors closely analyze long-term energy and REC cash flows. Wiser and Barbose (2008: 28) suggest that, "projects that have locked-in or hedged their energy or REC prices for at least 10 years are often viewed more favorably." Requirements for long-term REC contracts in a RPS can help ensure a sufficient revenue stream during the debt repayment period of renewable energy projects, particularly for smaller-scale projects, individual investors, or individual businesses and homeowners. Some states have adopted such long-term contract provisions as a component of their RPS. A few states have taken the long-term contract approach a step further by requiring specific length contracts for technologies subject to a carve-out.

3.2 Policies that Support the RPS Mechanism

3.2.1 Financial Incentives

Installation costs of some renewable energy resources, such as wind and solar, are much higher compared to that of coal-fired or natural gas-fired generation. While such resources often do have dramatically lower operation and maintenance costs (including fuel costs), the higher installation costs are still significantly onerous to investors. Low-interest and long-term debt tools – designed specifically for renewable generation systems – can greatly boost the appeal of such projects to investors (Cory and Swezey, 2007a; Kubert and Sinclair, 2009). Rebates and grants to reduce the upfont costs of renewable energy are another financial incentive that can help support meeting RPS goals.

3.2.2 Net Metering

Net metering allows electricity customers to generate electricity and offset their electricity consumption during a billing cycle (EERE, 2009). When customers generate electricity, their electric meters may actually turn backwards. This policy can allow customers to receive retail electricity rates for the electricity they generate. Currently, 37 states have adopted net metering standards (Varnado and Sheehan, 2009). If net metering is not available in a state or utility, a second electricity meter may be installed to measures only the electricity generated by the customer's generator. In such scenarios, customers usually receive below retail prices for the electricity they generate.

Net metering is an important part of encouraging investment in renewable energy. It increases the value of renewable energy produced, reduces the overall energy load on a utility's distribution system, and allows customers to "bank" electricity on the grid (EERE, 2009). Banking of electricity is used to describe the flux of energy usage among most customer-sited energy generators. The term "banking" is used because the electricity grid is essentially used as if it were a bank account. When customers' energy generation exceeds demand, they are electricity generators and are essentially making deposits into their electricity bank accounts. When their demand exceeds their generation, they are electricity consumers and are essentially taking withdrawls out of their electricity bank accounts. This ability to bank or store energy on the grid is important to the economic viability of customer-sited generation, particularly for intermittent generators such as solar and wind.

3.2.3 Interconnection Standards

The establishment of fair interconnection standards for smaller generators is vital in the support of the policies of net metering and RPSs that allow customer-sited renewable generation as an eligble resource. Interconnection standards establish application procedures and technical requirements for connecting renewable and other types of energy generation systems to a utility's distribution grid. These standards help ensure that small or distributed generation installations do not compromise the safety or reliability of the electric grid while establishing standard procedures and practices that are fair to the generator. The standards are typically developed and administered at the state level by a public utility commission. By 2008, 31 states had adopted interconnection standards to facilitate smaller-scale, clean energy generation (EPA, 2010a).

3.3 Delaware's RPS Experience

An RPS was enacted in Delaware in July, 2005 as part of Senate Bill 74. Eligible resources for the Delaware RPS include solar thermal and photovoltaic, wind, biomass, landfill gas, ocean thermal, tidal and wave energy, fuel cells reliant on renewable energy, hydropower (less than 30 MW), and anaerobic digestion. The Delaware Public Service Commission (PSC) was given responsibility for enacting rules and regulations and the first compliance year under PSC rules was 2007 to 2008. As altered by subsequent amendments to the law, the Delaware RPS presently seeks 4% of total retail electricity in the state to come from renewable sources for the 2009 to 2010 compliance year, with that figure increasing to 25% by 2025 to 2026 compliance year.

A carve-out for solar photovoltaic resources was created by legislation passed in 2007 and subsequently altered by legislation passed in 2010. The minimum requirement for solar photovoltaic resources started at 0.011% for 2008 to2009 compliance year and gradually increases to 3.5% by the 2025 to 2026 compliance years.

The use of tradable RECs and solar RECs (SRECs) has been established by the Delaware PSC as a means for electric utilities to meet compliance with the RPS (PSC, 2009). One REC or SREC is the equivalent of one megawatt hour (MWh) of renewable electricity when generated from eligible resources. RECs and SRECs from customer-sited generation are eligible to meet the RPS requirements. The PJM Interconnection's Generation Attributes Tracking System (GATS) works as the tracking and verification system for the RPS. When a REC or SREC has been used for complying with the RPS of another state, the same REC cannot be counted for compliance with the RPS in Delaware. Unused RECs and SRECs can be banked for three years from the date they are generated, with the exception that the Sustaianable Energy Utility can bank RECs and SRECs without a time restriction.

If a utility or electric supplier chooses to pay an ACP or if the PSC determines that a utility/elecrtric supplier has failed to acquire the required number of RECs for a year , it must pay the appropriate ACP into the Green Energy Fund. This Fund is administered by the Delaware Energy Office (DEO) and funds a renewable energy grant program. The price of the ACP is set by the State Energy Coordinator of the DEO, with consideration of how the ACP compares to REC market prices. A municipal utility can direct ACP proceeds into a fund created by its municipal members (PSC, 2009). To limit the utilization of ACPs and instead promote the purchasing of RECs, the ACP increases in following years if the utility chooses to pay the ACP in a given compliance year.

4.0 DISTRIBUTED RENEWABLE ENERGY GENERATION: BENEFITS AND OPPORTUNITIES

Generation from distributed renewable resources such as solar and wind are notable for modest, or even negligible, greenhouse gas emissions. The greater use of distributed generation (DG) may provide additional benefits such as reducing peak load, enhancing reliability, reducing transmission losses, stabilizing electricity prices, improving customer choice, and enhancing energy security (Byrne et al, 2005). These features make DG an attractive energy resource to be deployed as a way to mitigate the environmental problems engendered by the conventional energy system.

The development of RPS mechanisms, such as the solar carve-out, have expanded and improved the legal, regulatory, and economic environment for DG in the U.S. However, directly encouraging the use of DG has rarely been a direct goal of RPS mechanisms. More direct and comprehensive approaches to encouraging the greater us of DG in RPSs and other mechanisms is an evolving policy area.

4.1 Definition of DG

In general, DG refers to the application of small energy generators sited at or near customer sites to satisfy consumer demand or support the operation of the exisitng distribution grid. DG includes a host of energy generating technologies ranging from power plants common in the conventional energy system (e.g., diesel generators, gas combustion turbines, and gas combined cycle turbines) to fuel cells and renewable energy generators (e.g. wind, solar, and small-scale hydro). Combined heat and power systems are also usually considered to be a DG technology. DG can operate independently or in parallel (i.e., exporting energy) with the traditional power grid.

In contrast to DG technologies used by the conventional energy system, dispersed generation (i.e., customer-sited generation or behind-the-meter facilities) is generally defined as generation that is located at the customer's facility or “off” the utility system (i.e., stand-alone or off-grid) (Willis and Scott, 2000). Customer-sited systems are generally much smaller in size and are typically designed to serve an individual customer’s demand.

Many sources define DG as not exceeding a capacity of 10 MW in size (Willis and Scott, 2000). On the other hand, the Federal Energy Regulatory Commission’s (FERC) interconnection standards for small generators, which FERC has offered as a model for standards put in place at the state level, defines small or DG as 20 MW and less. In most cases, facilities under the purview of FERC would consist of those connecting with the grid at the transmission level, rather than facilities or installations linking up with the grid at distribution level, which typically fall under the jurisdiction of state public utility commissions. For the purpose of this year's READY project, DG is defined as both distributed and dispersed generation derived soley from renewable energy resources, connected to the gird at the distribution level, and is 10 MW or less.

4.2 Benefits of DG

Conventional electricity generation relies on centralized systems that consolidate revenue and decision making authority (Kiesling, 2005; Winner, 1982). By dispersing electricity production, distributed generation has the potential to increase autonomous decision making and community-level interaction among stakeholders with regard to power generation. It allows individual customers the freedom to become electricity producers and stimulates local economies through the purchase of technologies that must be sited and serviced in given locales (Hughes, 2009; National Renewable Energy Laboratory, 2003).

Another primary benefit of DG technology is its locational advantage compared to that of centralized power generating facilities. When located closer to the end-use customer, DG systems are not only able to avoid the efficiency loses associated with the long distance transmission and distribution (T&D) infrastructure of centralized systems, but also can delay or help avoid costly capital improvements to T&D networks. Along with avoiding T&D efficiency losses and costly investments, Byrne et al (2005) indentify the following list of additional benefits:

- Reduced peak load
- Enhanced reliability
- Stabilized and lower electricity prices in wholesale markets
- Reduced uncertainty accompanying bulk power generation
- Improved customer choice
- Enhanced energy security
- A boost to local economies

In addition, when DG is designed to employ renewable energy resources, such as PV and small-scale wind turbines that use no fuels in electricity generation, these systems can help to offset grid electricity demand and, therefore, may reduce a variety of emissions associated with conventional energy generating facilities.

4.3 Community Investment in DG

Many local governments and communities have a growing interest in taking to action to address sustainability issues. For example, ICLEI—Local Governments for Sustainability is network of more than 600 cities (including the City of Lewes), towns, and counties actively striving to achieve reductions in greenhouse gas emissions and create more sustainable communities (ICLEI, 2011). DG is an option for local governments and communities that want to make a direct, locally-sited investment in a cleaner power sources. The desire of communities to invest in DG can be seen in the Energy Efficiency and Conservation Block Grant (EECBG) Program, funded under the American Recovery and Reinvestment Act. In Delaware's Competitive Grants portion of EECBG, 13 of the 23 of local governments awarded grants included funding request for solar energy systems on community-owned property (DEO, 2011).

Local governments often have more flexibility than state or federal governments to be responsive to citizen preferences and community environmental concerns. The drivers behind local governments investing in DG are often grassroots community groups working to reduce the greenhouse gas emissions of their communities (CISE, 2011).

Community groups are also creating innovative models for direct community investment in DG. For example, a community group created the University Park Community Solar LLC (UPCS) which through community organizing completed one of the first community solar projects in the nation in July 2010. The total cost of the 23 kW solar system, located on the roof of the University Park Church of the Brethren in University Park, Maryland, was $130,000. The project was financed by members of UPCS — residents of University Park and other Maryland communities. The intent of members is to recoup their contribution as soon as possible with a sufficient return through a long-term power purchase agreement with the church and the sale of SRECs (UPCS, 2011).

4.4 Delaware's Experience with and Opportunities for DG

Although the deployment of DG has been modest in the State of Delaware, it is clear that developing renewable DG resources is a priority. As noted in the 2003 Governor's Energy Task Force Report:

> The most ubiquitous renewable resource in the state is solar energy, the energy available from sunlight. The amount of energy falling on Delaware in the form of sunlight over the course of an average year is 36.4 quadrillion BTUs. This is roughly one-third of current total U.S. energy consumption and 130 times the 280 trillion BTUs of energy consumed annually in the state including transportation fuels and electricity system losses (Delaware Energy Task Force, 2003: 65).

The Task Force Report further identified Delaware's renewable energy resource potentials, many of which are suitable for DG applications (see Table 4 in Appendix A).

Building on the work completed by the Task Force in 2003, Delaware has been at the forefront of advancing policies to facilitate the integration of DG technologies into its electricity sector. Delaware's RPS mechanism, for example, has been specifically tailored to incentivize solar technologies through a solar carve-out and an RPS multiplier for customer-sited solar applications. Other developments include the state-created Delaware Sustainable Energy Utility (SEU), which – in addition to being charged with implementing a wide variety of clean energy policies and programs – was authorized to facilitate the installation of 300 MW of customer-sited renewable energy by 2019 (SEU Task Force, 2007). Recommended to Gov. Jack Markell in the most recent Delaware Energy Plan for 2009-2014, the Governor's Energy Advisory Council recommended the following:

> The SEU should defray the cost of installing customer-sited renewable energy as a mechanism to reduce electric transmission and distribution energy losses, dependence on the electricity grid, peak electric demand, and Delaware's carbon footprint (Governor's Energy Advisory Council, 2009: 47).

It is clear that officials and other leaders in Delaware have acknowledged the importance and potential of renewable DG applications in the state. As discussed below, many states around the country are also giving more priority to the development of DG resources. In considering the direction of Delaware's DG policies and programs, reflecting upon the evolution of energy policy and the experience of other states can be instructive for advancing the contribution of DG resources as part of Delaware's energy portfolio.

5.0 CASE STUDIES

The following states were identified, after a review of the literature, to be leaders or innovators in forging significant policy approaches for the support of distributed renewable energy development.

5.1 Massachusetts

Although still in its infancy and largely unproven as a policy, the Massachusetts RPS solar carve-out is one of the more innovative attempts to develop and utilize the carve-out mechanism. Established as part of the Green Communities Act of 2008, the Massachusetts legislature authorized the Department of Energy Resources (DOER) to conceive a structure for deploying solar resources throughout the state. To do so, the DOER actively engaged a comprehensive stakeholder process beginning in the summer of 2009, and subsequently launched the solar carve-out program on January 1, 2010. While many states have established technology carve-outs through legislative action, Massachusetts gave the DOER significant discretion for establishing the goals and structures of the program (DSIRE, 2010d; Executive Office of Energy and Environmental Affairs [EOEEA], 2010).

5.1.1 Solar Carve-Out Obligations

All retail electric suppliers with RPS obligations will be required to demonstrate compliance with the solar carve-out as a percentage obligation of their total electric load served. Beginning with a total minimum standard set to 30 MW of operating capacity for compliance year 2010, estimated to generate 34,164 MWh (DSIRE, 2010d), the minimum solar requirement is to be adjusted annually by a base growth rate of 30%. The Massachusetts carve-out is particularly unique in that the yearly minimum standard is adjusted to reconcile for either an over- or under-saturated market for SRECs (DSIRE, 2010d; EOEEA, 2010).

Generation from qualified facilities must be individually metered, and once a project is approved, the developer has four years to achieve operation (DSIRE, 2010d). In an effort to cultivate various size systems (less than 2 MW) across multiple sectors, the DOER encourages generators (sellers) and retail electric suppliers (buyers) to enter a variety of financial agreements to generate appropriate rates of return and revenue certainty for solar investors. In addition, the DOER has developed an SREC Clearinghouse Auction as an alternative trading mechanism to ensure not only a balanced market, but also to provide a means of revenue certainty for those investing in solar systems.

The minimum goal for the solar carve-out program is capped at a total of 455,520 MWh, which will be sufficient for the installation of approximately 400 MW of solar capacity. When sufficient applications have qualified to meet the cap, qualification of additional solar installations will be eligible for compliance with Class I under Massachusetts' traditional RPS. Projects eligible for the solar carve-out must be located in Massachusetts, must be customer-sited systems, must not exceed 2 MW in size, and must be installed on or after January 1, 2008. Projects that have previously received funding through State programs or ARRA (American Recovery and Reinvestment Act of 2009) funding are ineligible (DSIRE, 2010d; EOEEA, 2010).

The use of SRECs is a primary tool for fulfilling the solar carve-out. As the DOER notes, successful development of solar PV systems requires an appropriate rate of return and revenue certainty. In this regard, revenue certainty surrounding the SREC market is particularly important. In some states, the long-term value of SRECs is bolstered by requiring utilities to enter into long-term contracts for securing resources to comply with RPS requirements. Rather than mandating long-term contracts, the DOER has established a clearinghouse auction as an alternative method to reinforce SREC revenue certainty and nurture a stable and growing market for the solar industry (DSIRE, 2010d; EOEEA, 2010).

5.1.2 SREC Auction – DOER Price Support Mechanism

The Price Support Mechanism program offers PV generators an option, to deposit into a DOER account, excess SRECs that will be auctioned off for a fixed minimum price of a known term. This account is set up through the New England Generation Information System (NE-GIS). The term is initially set at 10 years. However, if the supply of SRECs is in excess, the term will be shortened to reduce the solar subsidy and slow the overall growth rate. The term is also subject to additional triggers, discussed below, to assure a balanced and robust SREC market. All projects installed in a given year receive the same term as set forth in that year (EOEEA, 2010).

The SRECs that are opted to the auction are re-minted by the NE-GIS into Extended Life SRECs with a shelf life eligible for compliance over the next two compliance years. The auction will establish the fixed price at $300 per SREC. If an insufficient volume is bid, the auction will be repeated with one additional year added to the shelf life of Extended Life SRECs. Essentially, the auction design provides a range of SREC price certainty between the ACP and the fixed auction price of $300 per MWh. Massachusetts expects that the price band and the opt-in term offered in the year of installation will provide the requisite revenue certainty for project financing (EOEEA, 2010).

Auction revenues will be redistributed to the generators who made deposits, minus the auction fee of 5% or $15 per MWh. The auction fee is expected to ensure that the auction account is an option of last resort and to motivate generators to seek market trades.

5.1.3 Alternative SREC Markets

The SRECs that are generated after a generator's opt-in term has expired will find a market to sell SRECs through either the spot market or under short-/medium-term contracts. These markets will maintain viability due to the growing obligation of the minimum standard under the carve-out. The DOER suggests that generators will be willing to sell ineligible SRECs in a long market, and that compliance entities would be willing to buy SRECs in the short market to avoid the ACP (EOEEA, 2010).

The ACP has been initially set to $600/MWh for 2010. The DOER maintains the discretion to reduce the ACP rate on an annual basis, but no more than 10% per year.

Obligated entities are allowed to bank purchased SRECs for the following two years of compliance. Banked SRECs cannot be used to fulfill more than 10% of compliance in any given year. This will allow SREC market conditions to be more quickly recognized, toward maintaining a balanced market (EOEEA, 2010).

5.1.4 Design Triggers and Program Adjustments

While the DOER encourages financial agreements in the marketplace, its establishment of a clearinghouse auction and its design of market triggers further seek to ensure a balanced and robust SREC market, one that will stimulate appropriate solar development opportunities. Indeed, its design of triggers is perhaps the most unique aspect of Massachusetts' carve-out structure. Initiated with a minimum standard for 2010 and an annual growth rate, the DOER has integrated triggers that will reconcile actual market conditions with program expectations (EOEEA, 2010).

ACP Reliance (short market). If compliance is achieved with a non-trivial quantity of ACPs in any given year, the market is short of SRECs. To bring the market back into balance, the minimum standard growth rate is slowed and the opt-in auction term for new installations is reset to 10 years, thereby enhancing the solar development incentive.

Auction Account Reliance (long market). If generators access opt-in rights and deposit a non-trivial quantity of SRECs into the auction in any given year, the market is long of SRECs. To bring back balance, the minimum standard growth rate is increased and the opt-in auction term is reduced for new installations, thereby diminishing the solar development incentive.

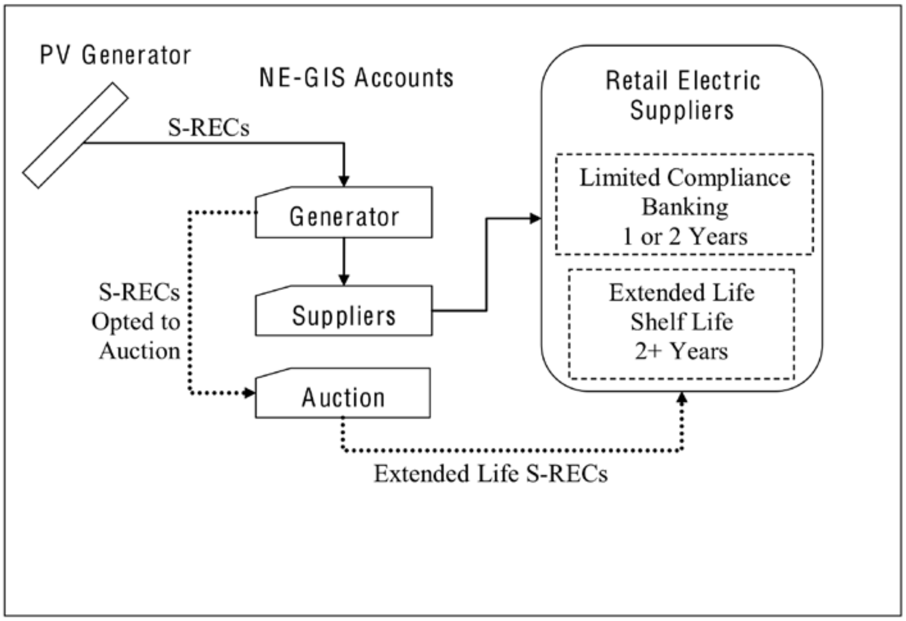
Minimum Standard Cap. When the minimum standard cap is reached, the qualification of additional solar installations will be transferred to the RPS Class I program and the minimum standard for the solar carve-out will remain constant at the cap level, until opt-in terms have expired and Extended Life SRECs have reached term. At this point, the carve-out is merged into the RPS Class I program in full.

The following conditions apply to the SREC clearinghouse auction:

- Solar projects are awarded an opt-in term of 10 years
- SRECs are re-minted with an initial shelf life of 2 years
- DOER holds a fixed-price auction within 30 days after annual compliance filings and adjustment to the minimum solar carve-out standard for the coming year
- Fixed price of $300/MWh; bids based upon volume at fixed price
- Auction Safety Valves – if the auction does not clear SREC volume, shelf life increases to 3 years and the auction is repeated
- If the auction does not clear 3-year SRECs, the minimum standard (in MWh) for the coming compliance year is increased by the total volume of deposited SRECs and the auction is repeated
- Long Market and Short Market Adjustment Triggers adjust the Auction Opt-In Term to ensure SREC market stability
- Auction revenues are distributed to generators that initially deposited SRECs
- Auction Fee = 5% or $15/MWh; this feature helps to make the Auction Account the option of last resort and motivates generators to seek market trades

As illustrated in Figure 2 below, the SREC market will recognize two types of SRECs: (1) SRECs generated within the term of eligibility to opt-in to the auction; and (2) SRECs that are past their term of eligibility and are therefore ineligible.

Figure 2. Massachusetts SREC Market Structure



Source: EOEEA, 2010

The minimum standard is increased by an annual growth rate of 30%, which is also adjusted according to SREC oversupplies or shortages in the previous compliance year. This adjustment function maintains a robust market by assuring the value of SRECs through the auction and protecting ratepayers from unrelenting dependence on ACP compliance.

As an example of how the general calculation is conducted, the following formulas are provided in Table 1 below.

Table 1. Calculations for the Minimum Standard in Massachusetts

MinStnd%, CY = MinStndMWh, CY / Total RPS Load ObligationMWh, CY-1
For Compliance Year 2010: MinStndMWh, 2010 = 30 MW x 365 x 24 x CapFct (=0.13) = 34,164 MWh MinStnd%, 2010(estimated) = 34,164 MWh / 50,243,788 MWh = 0.0680%
For Compliance Year 2011: MinStndMWh, 2011 = (MinStndMWh, 2010 + MinStndMWh, 2010 x 1.3) – (ACP Volume2010 + Banking Volume2010 + Auction Volume2010)
For Compliance Years after 2011: MinStndMWh, CY = [MinStndMWh, CY-1 + (MinStndMWh, CY-1 – MinStndMWh, CY-2) x 1.3] – (ACP VolumeCY-1 + Banking VolumeCY-1 + Auction VolumeCY – 1)

Source: EOEEA, 2010

5.2 Colorado

Passed by ballot initiative in 2004, Colorado's RPS has been substantially strengthened by legislation since its inception. In the spring of 2010, the Colorado State Legislature amended the state's RPS to require 30% renewables by the year 2020, up from 20% by 2020. Even with the second most aggressive RPS in the country (California requires 33% by 2020), Colorado officials are confident that the state's goal is achievable (Severance, 2010).

5.2.1 Solar- to DG-Specific Carve-Out

Originally designed with a solar carve-out of 4% by 2020 (with half the annual requirement to be derived from customer-sited solar facilities), the 2010 amendments have replaced the solar carve-out provisions with a DG-specific carve-out. Requiring a 3% DG share by 2020, the current carve-out requires that half of the annual requirement is derived from customer-sited facilities.

The RPS also requires that utilities provide a solar rebate offer for the installation of customer-sited solar-electric systems, applicable across residential, commercial, and nonprofit sectors (DSIRE, 2010e). Under this mandate, the rebate program – Solar*Rewards – offered by utility Xcel Energy has developed into one of the most successful in the country. By late October 2009, Solar*Rewards had already resulted in the installation of 4,300 solar PV systems in Colorado, with 38 MW deployed (Xcel Energy, 2010). The utility expects to have supported 258 MW of distributed solar development by 2020 (DSIRE, 2010e). Moreover, Xcel Energy has announced that it is ahead of schedule for meeting the 2020 RPS requirements while remaining within a 2% per-year cost control mechanism, thus complying with the RPS in ways that protect Colorado ratepayers.

5.2.2 Community-Based Projects and Contract Durations

Certain RPS mechanisms in Colorado also have been tailored specifically for electric cooperatives and eligible municipal utilities. For instance, electricity generated at a "community-based project" – defined as a project less than 30 MW, located in Colorado, and owned by residents of a community or by nonprofits, cooperatives, local government or tribal councils – receives a 150% credit for compliance (DSIRE, 2010e).

The rules and regulations for Colorado's RPS have specified criteria for both renewable energy supply contracts and REC contracts (DSIRE, 2010e). Most importantly, both types of contracts require certain contract durations. For renewable energy supply, contracts shall have a minimum term of 20 years (or shorter at the sole discretion of the seller). In terms of REC agreements, contract duration shall have a minimum term of 20 years if the REC is a customer-sited solar system, except that such contracts for systems between 100 kW and 1 MW may have a different term if mutually agreed to by the parties.

5.2.3 Economic Impacts and Prospects

The design and planning of Colorado's RPS over time has established an effective foundation for the state to aggressively increase its renewable energy goals. In advocating for the passage of HB 1001 – the 2010 RPS amendment package – Vote Solar and Environment Colorado studied and examined the economic and environmental impacts of a 3% DG carve-out. Table 2 below summarizes the potential benefits as identified by these stakeholders.

Table 2. Prospective Gains From Colorado's DG Carve-Out

Summary of Potential Benefits	
JOBS	33,325 Total New Construction-Period Jobs
ECONOMIC DEVELOPMENT	$4.3 Billion in Lifetime Economic Output
WATER SAVINGS	6.8 Billion Gallons of Water. Equal to the Annual Consumption of 3,300 homes.
CLEANER AIR	30 Million Tons of CO_2 Avoided. Equivalent to Taking 669,730 Cars off the Road.

Source: Vote Solar and Environment Colorado, 2010

Following Colorado's RPS launch in 2004, the state is now home to some 200 solar firms (Kiely, 2010). Lawmakers expect the more ambitious standard as passed in 2010 to boost this number still further, while also enticing the inflow of investment capital and ensuring that renewable energy remains "Colorado's fastest-growing economic sector" (Tyler, 2010).

5.3 Nevada

Nevada first established an RPS through electricity sector restructuring legislation in 1997. In 2001, the RPS was revised to increase the minimum renewable energy requirement by 2% every two years, towards 15% by 2013. In 2005, Assembly Bill (AB) 3 was passed, allowing energy efficiency measures to be used to fulfill a portion of the RPS requirement. Eligible efficiency measures must actually reduce energy demand, as opposed to shifting demand to off-peak hours. Nevada's AB 3 also is notable for establishing Nevada's solar carve-out, as discussed further below. In 2009, SB 358 increased the state's RPS requirement to 25% by 2025. An amendment to the bill also raised the solar carve-out from 5% through 2015, to 6% beginning in 2016 (DSIRE, 2010f).

5.3.1 Distributed Generation

Nevada has a number of multipliers for a variety of energy and conservation technologies (DSIRE, 2010f). They are as follows:

- 2.4x Solar PV
- 2.45x DG solar (determined by regulation)
- 1.05x Energy efficiency
- 2.0x Electricity saved during peak hours

As noted above, in 2005, AB 3 was passed to allow energy efficiency measures to be used to satisfy a portion of the state's RPS requirements. In 2007, AB 1 expanded the definitions of eligible energy efficiency initiatives to include district heating systems powered by geothermal hot water.

5.3.2 Enforcement Mechanisms and REC Market Conditions

The Public Utilities Commission of Nevada (PUCN) oversees a program that administers portfolio energy credits (PECs). Nevada has set up its own REC tracking system called Nevada Track Renewable Energy Credit (NVTREC). The PUCN oversees REC administration.

Nevada's RPS does not have an alternative compliance mechanism and has been criticized more generally for having "weak enforcement mechanisms" (Cory and Swezey 2007b: 27). A 2004 compliance report from the Nevada Renewable Energy and Energy Conservation Task Force (NRETF) recommended that an ACP be implemented (NRETF, 2005), but Nevada still remains without an ACP. When asked about Nevada's lack of an ACP, PUC staff responded, "in Nevada we prefer bundled energy with PECs and delivered into the Nevada electric utilities system" (Harris, 2010). From this response, and from observations of the NVTREC tracking system, it seems that Nevada, as opposed to many other states, keeps much of its REC market within state borders. This is a result of two factors. First, Nevada, like many other states, views renewable energy as a potential source of in-state jobs. By keeping its renewable energy market and REC market in-state, Nevada hopes to capture the bulk of in-state job potential. Second, Nevada has one of the oldest RPS policies in the U.S. Its REC tracking system, NVTREC, was developed to replace the state's original paper tracking system. At the time, few tracking systems were in operation, thus Nevada's only choice was to develop it own, intrastate tracking system (Harris, 2010). Now that the Western Renewable Energy Generation Information System (WREGIS) is established, Nevada utlizies both the NTREC and WREGIS systems (Harris, 2010).

5.3.3 Dynamics Surrounding Development of the DG Carve-Out

Nevada's AB 3, in addition to establishing the state's solar carve-out and permitting energy efficiency to meet RPS mandates, also reduced and delayed the short-term RPS targets, while increasing and extending long-term targets. In the two years prior to the bill's passage, Nevada Power had failed to meet the minimum RPS requirements, and Sierra Pacific Power had failed to meet the solar requirement (NRETF, 2005). As a result, it can be speculated that the changes to the RPS were partly an attempt to respond to the issue of utility noncompliance. However, in proceeding years, Nevada Power and Sierra Pacific Power have continued to struggle to meet their solar and non-solar RPS requirements (NV PUC, 2009; DSIRE, 2010f).

The dynamics surrounding the most recent increase in Nevada's solar carve-out indicate the complexity of the issue as well as the desires of various stakeholders. To date, much of Nevada's solar carve-out has been satisfied with large-scale, utility-size solar installations. Opponents of the solar DG efforts have included utility-scale solar operators, who have indicated that DG solar is not financially viable (Berzon, 2009). They also have indicated that residential customers are not taking advantage of rebates because residential solar has appeared to be too expensive. However, many advocates for smaller-scale solar installations compatible with residential needs argue that support for these applications has been lacking in Nevada (Berzon, 2009). Solar advocacy groups and the AFL-CIO have accordingly called for raising Nevada's RPS to 30% by 2020 and making the solar carve-out exclusively for distributed generation (Carmichael, 2009).

5.4 Arizona

Arizona is considered to be an early leader among U.S. states in the adoption of renewable energy programs. Its outstanding solar resources, characterized by high direct and diffuse radiation, are particularly amenable to flat plate and concentrated PV applications. The effective capacity factor for solar resources in the state has been rated at 18 to 25%, as impacted by angle and tracking settings (Arizona Department of Commerce [ADC], 2007).

5.4.1 The Renewable Energy Standard and DG Carve-Out

The Arizona Corporate Commission (ACC) – which maintains jurisdiction with regard to the rates charged and quality of service offered by public utilities – enacted a baseline requirement for a solar portfolio standard in 1996, while restructuring its electric power sector (UCS, 2008). The early 1996 rule established targets for 0.2% and 1% solar energy, respectively – out of total energy supply – by 1999 and 2003. A later standard, the Environmental Portfolio Standard (EPS), repealed the 1996 target and mandated that regulated utilities produce 0.4% of their electricity from renewable sources by 2002, an amount that was to rise to 1.1% during the period of 2007-2012. Solar electricity was designated to provide 50% of the overall renewable energy portfolio by 2001, rising to 60% in the period of 2004-2012.

More recently, in 2006, the EPS was revisited by the ACC and renamed the "Renewable Energy Standard" (RES). A new goal was put into place, for the share of renewable energy in Arizona to reach 15% by 2025, with 30% of that yearly total (in turn) to come from distributed energy installations. Some 50% of the total distributed renewable energy mandate must be achieved in the residential sector, and 50% must be obtained in the non-utility, non-residential sector. The compliance schedule for these requirements is listed in Table 3 below.

Table 3. Renewable Retail Sales and DG Compliance Schedule

Year	(%) Retail Sales from Renewable Sources	(%) Requirement from Distributed Renewable Energy
2006	1.25%	0%
2007	1.50%	5%
2008	1.75%	10%
2009	2.00%	15%
2010	2.50%	20%
2011	3.00%	25%
2012	3.50%	30%
2015	5.00%	30%
2020	10.00%	30%
2025	15.00%	30%
2030	15.00%	30%

Source: USC, 2008

Eligible renewable energy sources are biogas, biomass, certain hydropower facilities, geothermal, solar electricity, fuel cells utilizing solely renewable fuels, hybrid solar electric/wind, wind generation, and landfill gas. Eligible distributed renewable resources include biogas and biomass, geothermal, fuel cells, solar electricity, other solar technologies (hot water; daylighting; heating, ventilation, and air conditioning; industrial process heating and cooling), wind power generators of less than 1 MW, and combined heat and power applications using renewable energy. For new hydropower facilities, hydropower capacity is limited to less than 10 MW, and must be installed after January 1, 2006.

5.4.2 RECs and Mutipliers

A utility subject to the 1996 renewable energy standard can utilize RECs to achieve compliance with its yearly mandate. "Extra credit" multipliers can adhere to in-state solar installations, more general early installation of certain technologies, and in-state manufactured contents. These multipliers, while additive, cannot go beyond 2, and any RECs coming from technologies installed after December 31, 2005 are ineligible for multipliers (DSIRE, 2010g). Accrued costs for renewable energy may be recovered by utilities via a monthly surcharge assessed by each utility under ACC approval.

5.4.3 Supportive Measures

In June 2007, the ACC passed a rule for interconnection standards applicable to distributed generation in Arizona. The allowed capacity for such facilities is up to 10 MW. Meanwhile, to support the solar carve-out, the state of Arizona provides financial incentives such as rebates and tax credits. For instance, Arizona gives a $2.50/watt rebate to commercial customers. Also, on top of a federal tax credit for 30% of the utility price, an Arizona state tax credit applies to 25% of the utility cost (Mayes, 2010).

Arizona, as one of the premier states to focus on solar energy development, has further evolved a supportive infrastructure for research and development of the technology. University-industry linkages in Arizona are well developed, with the University of Arizona and Arizona State University (ASU) as noted actors on 3rd generation solar cells, characterization equipment, and clean rooms. ASU, in addition, has been host to the Power Systems Engineering Research Center, made up of 13 universities and 39 companies and funded by the National Science Foundation. The state has further hosted the STAR facility which assesses emerging energy technologies, with only two other such actors in the world; these include the Australian National University and the Weizmann Institute in Israel (ADC, 2007).

Despite these significant infrastructure investments in energy technology development and education, Arizona has worked to identify solutions to lingering challenges, to include expensive costs for solar technologies, still immature technologies, and inadequate public participation in programs for installing rooftop PV. Toward addressing these challenges, Arizona stakeholders released a Solar Electric Roadmap in 2007, with key initiatives such as establishing solar zones, developing a Solar Center of Excellence, and establishing "Sustainability Partners" (ADC, 2007).

For each general set of activities, clear timetables are delineated for actionable goals as apportioned among key actors, with efforts to draw upon and expand (where possible) the contributions of existing educational facilities and research centers. These efforts intend to leverage not only stakeholder involvement and all available resources in the support of technology research and commercialization, but further intend to inform the design of future RES requirements, utility programs, tax credits, and job training funds in the state. The wider ambition is to achieve – by 2020 – 1,000 MW of solar energy, some 3,000 new jobs, and a leading position within the global solar industry (ADC, 2007).

Compared with similar activities in other states, the more rapid adoption of renewable energy policies in Arizona has given it a competitive advantage as a role model for clean energy, especially in the area of solar policy. The push for university-industry linkages for solar technology advances in Arizona, as boosted by the state's Solar Roadmap, now intends to take such policy achievements to the next level in terms of systemic gains for the state.

5.5 New Jersey

New Jersey has emerged as a national leader among states in support for solar energy development. Since 2001, when 6 PV systems were installed in the state, New Jersey had – within just five years – achieved some 1,200 installed projects. Its policies and supportive programs have helped to make New Jersey a top state for solar energy installations, following California, with some 4,000 residential installations by 2010 (New Rules, 2006; SunRun, 2010).

5.5.1 Policy Design

New Jersey established its first RPS in 1999 and has since revised its RPS another three times. Refined under AB 3520 in 2010, the newest revised RPS requires that electricity utilities must procure 22.5% of the total electricity sold in New Jersey from renewable resources by 2021. Electric utilities also need to procure 2,528 GWh from in-state solar electricity generators by the year 2021 (DSIRE, 2010c).

5.5.2 REC Markets and ACPs

New Jersey's RPS is predicated upon a REC market intended to stimulate new and existing renewable energy resources. New Jersey's RPS is broken up into two primary tiers: Class I resources, originally set to provide 17.88% of the total renewable energy supply by 2021; and Class II resources, intended to provide 2.5% of total renewable energy. As noted previously in this report, Class I renewables include wind, solar electric, wave or tidal energy, geothermal, landfill gas, anaerobic digestion, fuel cells using renewable fuels, and certified biomass. Class II renewables include hydropower smaller than 30 MW and resource-recovery facilities (DSIRE, 2010c). A specific solar set-aside was originally set to provide 2.12% of the RPS total, but this target has subsequently been changed to a minimum 2,518 GWh by 2021 (DSIRE, 2010c). No separate requirement exists for distributed renewable energy (DSIRE, 2010c).

Under New Jersey's RPS, electricity suppliers may fulfill these mandates and verify compliance through the acquisition and submission of RECs and SRECs. Solar PV generators can produce SRECs for 15 years; beyond that time frame, Class I RECs (not SRECs) are issued for the generation from solar PV generator. Before 2007, under then-existing rules, suppliers were not allowed to use RECs or SRECs from electricity produced at the location of the customer-generator, except when that facility was eligible through net metering. With SB 2936 in 2007, all grid-connected facilities, solar or otherwise, became eligible for the generation of RECs or SRECs (DSIRE, 2010c).

For the New Jersey RPS, RECs are issued by PJM- GATS. Based on New Jersey's current administrative rules, RECs can only be used for compliance in the "energy year" they are generated, while SRECs can be used for compliance in either the energy year they are generated or the next energy year (if they are generated after June 1). However, under AB 3520, after 2011, both RECs and SRECs are eligible to be used for compliance in the year they are generated as well as the following two years (DSIRE, 2010c).

If an electricity supplier does not fulfill its RPS requirement in one year, it is required to make alternative compliance payments (ACPs) or solar alternative compliance payments (SACPs) to compensate for the balance. Prices for ACPs and SACPs are established by the Board of Public Utilities (BPU). The ACP rate is $50/MWh for Class I and Class II RECs; for SRECs, the rate was set at $711/MWh for the year 2009, dropping to $594/MWh by the year 2016 (DSIRE, 2010c). Electric utilities are required to file an annual report with the BPU by September 1 to show that they have met the requirement for the previous year. Failure to adhere to this directive may lead to the suspension of licenses, the assignment of financial penalties, and/or other penalties.

5.5.4 Distributed Solar Energy Development and Utility Programs

Atlantic City Electric (ACE) supplies electricity in the southern part of New Jersey. In its *Blueprint for the Future*, released in 2007, ACE committed to a 2012 target of installing a total of 500 kW solar capacity on company-owned and -leased buildings. Moreover, ACE provides customers with installation service compensation and financing and maintenance services, all to promote customer-sided solar electricity. Through ACE's estimation, the program will increase solar capacity in its service area by 3.5 MW (Atlantic City Electric Company, 2007).

The Public Service Electric and Gas Company (PSE&G), another electricity supplier in New Jersey which serves almost 75% of the state's population, also offers financing to support solar PV system installation on homes and commercial buildings. From its first-wave solar loan program, launched in 2008, PSE&G obtained approval in November 2009 from the BPU to enlarge the program, for $248 million in available loans. It is estimated that this program will help ensure the development of up to 81 MW of solar power at homes, businesses and municipal sites throughout the state (PSE&G, 2010).

These utility-based programs are further augmented by energy businesses that have found fresh opportunities to benefit from the provision of distributed solar installations in the state. One such company, SunRun, provides solar panel installation and operation services contracts with no base payment financing to New Jersey residential customers (SunRun, 2010).

6.0 POLICY RECOMMENDATIONS

Based on the review of efforts to support DG and renewable energy in Massachusetts, Colorado, Nevada, Arizona and New Jersey, the following considerations may be valuable in assessing future directions for policy development in Delaware.

6.1 Renewable Energy Policy Evolution

Historically, many states – including Delaware – have relied upon some form of rebates or grant-based funding incentives to support the installation of customer-sited renewable energy systems. However, the current policy trend is a transition from a reliance on grant-based funding support to a more market-based incentive structure.

The limits of grant-based funding can be seen in Delaware's recent experience. For a number of years, the Green Energy Fund (GEF) successfully supported investment in small-scale renewable systemsin the State. However, by 2009, GEF resources were unable to keep up with the demand for grants and a backlog of applicants developed that continues today. Delaware is approaching a point at which a more market-based structure may present greater advantages as an effective form of support for the deployment of renewable technologies and help relieve the burden on the GEF.

Delaware has undoubtedly been one of the leaders in the development of innovative renewable energy policies. For example, the state has been in the top ten of states in terms of the per-capita PV installation rate for a number of years and in 2009 exceeded Nevada's rate (Sherwood, 2010). The statutory changes to the GEF and RPS in 2010 reflect Delaware's willingness to move in new directions in renewable energy policy. A further policy evolution would be building on a strong renewable foundation in Delaware developed over the past decade.

6.2 Managing the Introduction of Multipliers

Many states use multipliers, including Delaware, to incentivize and increase the value of particular forms of renewable energy and these multipliers can be an effective way to bolster the use of a diversity of energy sources. However, multipliers have several challenges. Mulitipliers have the potential to dilute and undercut RPS goals. For example, if RPS goals are set, but multipliers are introduced at a later date, a multiplier of 2x could cut the real impact of the RPS in half, in terms of the actual amount (in MWh, etc.) of the renewable energy generation incentivized by the RPS.

If Delaware is considering multipliers for incentivizing the use of particular DG technologies, RPS goals should be revisited. Coordination between the establishment of RPS goals and the introduction of multipliers can help alleviate the negative consequences of multipliers. Ideally, multipliers will be introduced at the same time that RPS goals are set or raised. If multipliers are introduced or changed at a later point, the RPS goal also should be revisited at that time, and if necessary, changed.

Multipliers pose a further challenge in establishing appropriate multiplier values. A careful approach should be taken in the introduction and valuation of multipliers, so that they represent a fair assessment of the resource's value and provide the correct incentive to overcome market barriers.

6.3 Strategies in Setting ACPS

Insight into the strategic issues surrounding setting specific ACPs may be valuable to the future development of Delaware's renewable energy market. ACPs provide a flexible mechanism for adjusting RPS targets and goals. ACPs also establish a REC ceiling price. Establishing the most appropriate price point for the ACP, alongside its potential adjustment over time, is a challenge. If the ACP is set too low, the REC trading price could fall to such levels that the potential revenue from RECs fails to provide a sufficient incentive for for investment in DG. This is especially the case for technologies that remain at a competitive disadvantage (such as small-scale solar) and require a certain level of revenue certainty to stimulate investment. On the other hand, an ACP that is set too high could create an undue burden on ratepayers since RPS compliance costs are potentially recoverable by utilities through rate structures. Careful consideration and assessment of market conditions can help to establish an ACP that will provide the appropriate support mechanism for investment in DG while simultaneously protecting ratepayers.

Another challenge is how to properly adjust the ACP over time. One approach is to is schedule automatic downwards adjustments to the ACP each compliance year as renewable energy industries expected to mature, become more financially self-sufficient, and experience costdeclines. States that have used this approach include New Jersey and Maryland. A potential downside of this approach is too rapid pre-determined declines in the ACP that don’t consider current market conditions. Another approach, which is Delaware's current approach, is to allow governmental authorities (for Delaware, the State Energy Coordinator) to adjust the ACP as needed in consideration of ongoing market conditions. The potential downside of this approach is the as-needed mechanism which doesn’t require regular assessments of market conditions. Some combination of both approaches could be an appropriate way to make sure that ACPS decline regularly in accordance with market conditions.

Another complicating matter in setting appropriate ACP levels is the fact that the capacity of renewable energy technologies is highly variable. Solar PV systems, for instance, can range anywhere from a few kWs to well over 10 MW. As such, the financial circumstances for small-versus-large systems are quite different. Large-scale, utility-sized systems, which may take advantage of economies of scale, often can attract sufficient levels of investment from market players and from REC buyers interested in reducing the transaction costs associated with multiple REC purchases. Small systems, meanwhile, often have a higher REC price point and less flexibility when it comes to securing financial resources for investment. Therefore, while a particular ACP may prove appropriate for systems of a certain size, its effectiveness for other systems may be questionable. Perhaps in addition to establishing technology-specific ACPs, consideration should be given to designing capacity-specific ACPs.

6.4 Evolving DG Benefits from the RPS Solar Carve-Out

The RPS mechanism of many states, including Delaware and New Jersey, contain no specific policy to require DG. A solar PV carve-out has instead been the de-facto DG strategy because of the modular nature of the technology, and the nature of the solar resource and available land in the Mid-Atlantic. The fast development of distributed PV generation in New Jersey and Delaware suggests that a carve-out policy can be an effective mechanism for supporting DG penetration if supporting policies such as net metering and reasonable interconnection standards are in place.

In light of the significant ramping-up of solar carve-outs in the coming years for numerous RPSs including Delaware's, more consideration should given to how the solar carve-out should be met — mostly utlity-scale installations, mostly through DG installations, or through some combination. There are several advantages in pursuing DG rather than constructing centralized utility-scale solar farms. First, no transmission and distribution (T&D) loss occurs from distributed solar generation and a portion of the electricity generated will be lost. Thus, the total efficiency of solar energy achieved through this particular approach will be lowered. Second, solar PV technology usually generates electricity at times of peak customer demand which conincides somewhat closely to the time T&D lines typically become congested. Third, DG can be installed and maintained at numerous sites in a given geographic area, opens up possibilities for more equitable economic development across communities or regions. Finally, distributed generation also can favor cleaner sources of electricity, minimizing local pollution and helping to mitigate global warming. By spreading electricity generation across the state of Delaware, distribution generation can help all state residents reap the benefits – and avoid many of the risks – associated with traditional electricity generation.

6.5 Policies to Encourage Long-Term REC Contracts

Delaware has no requirements or incentives for long-term REC purchases in the RPS. Requirements for long-term REC contracts in a RPS can help ensure a sufficient revenue stream during the debt repayment period of renewable energy projects, particularly for smaller-scale projects, individual investors, or individual businesses and homeowners. Some states have adopted such long-term contract provisions as a component of their RPS. Exploring the most appropriate way to encourage long-term REC contracts in Delaware's RPS may be a valuable effort in the goal of developing a more robust renewable energy market in the state.

6.6 Institutional Support and Linkages to Industry

As states pursue renewable energy goals, in particular greater reliance on DG, policy goals are being augmented by more comprehensive planning at the state level to link clean energy consumption to in-state research and development, demonstration and commercialization, and new manufacturing opportunities. These efforts entail multi-sectoral targets, identification of key players (government agencies, industries or firms, educational or research institutions, etc.), timelines for the achievement of major initiatives, and frameworks for securing or building upon vital resources (financial or otherwise).

The value of such framework approaches, in linking policy to collaborative and comprehensive institutional support, in both the public and private sectors, is three-fold. First, comprehensive visioning and involvement encourages diverse stakeholders to identify gaps in current approaches and strategies for overcoming them. Second, once those strategies have been identified, shared efforts can allow for the leveraging of available assets in order to capture synergies and reduce redundancies of time and effort. Third, where significant investments are required to achieve specified goals – as with the ongoing research of technologies in order to prepare them for commercialization and deployment in very localized geographies and markets – an integrated approach may be the best means by which to expedite gains that may otherwise take years or even decades to unfold. This is seen, for example, in Arizona's bid for 1,000 MW of solar installations, some 3,000 new jobs, and the achievement of a leading position in the global solar industry, all by 2020. The inventorying of capabilities, the outline of in-state consumer and economic needs, a decade-long research initiative uniting academia with industry, and outreach to market Arizona's ambitions at national scales – these efforts jointly seek to inform and support planning, budgeting and evaluation of policies and programs for renewable energy. Joint collaboration can help ensure the appropriate design of multipliers that encourage the local production of technologies or the use of local labor, alongside zoning and permitting rules that facilitate new installations. Local industries also may benefit from heightened public education and outreach initiatives that spotlight emerging market demand for distributed renewable generation and the range of incentives that exist to support such installations. Support for certification programs that offer information on technology standards and performance may further bolster the credibility of local firms entering the renewable energy marketplace and engaging in the provision of related goods or services.

In sum, where obstacles in the form of higher prices and gaps in learning continue to exist, the active pursuit of frameworks for creating policy-stakeholder-institutional linkages can help to nurture a supportive environment for cultivating both demand for distributed renewable energy technologies and the local industries to serve new customers.

7.0 CONCLUSION

The number of states pursuing strategies for the inclusion of renewable resources into their energy supply portfolios speaks to the growing emphasis on sustainability as a foundational component to U.S. energy policy. Sustainability in this context refers not only to reduced greenhouse gas impacts by producing electricity from sources such as PV and wind, but also the gains to be had from a more decentralized, distributed approach to energy service provision.

The recommendations included in this report reflect financial, technical and stakeholder-based considerations that may be of value, in assessing the future direction of policy to assist cost-effective and equitable installations of renewable energy technologies at a multitude of scales and locations in Delaware. Their role in aiding visible and growing numbers of such installations in a number of states, and their contributions to bolstering state electricity supplies, meeting consumer needs and fulfilling environmental goals, suggest the strong potential for renewable-based, distributed generation to be a significant player in Delaware's energy sector.

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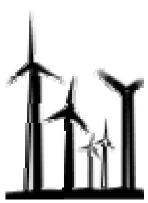
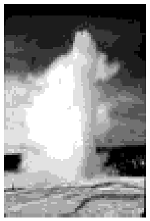
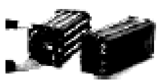
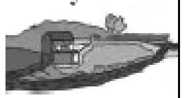
APPENDIX A

Table 4. Characteristics of Delaware's Renewable Energy Resources

Resource	Utilization Technologies	Applications	Availability	Responsiveness to Demand	Cost	Environmental
Solar Energy 	End User-Sited Photovoltaics	§ Stand-alone off-grid power § Residential and commercial buildings to displace utility power § PV/UPS systems for residential and small commercial applications	Widely available; good solar resource in Delaware, although not suitable for concentrating collectors.	Usually not dispatchable, although batteries can be used for peak shaving. Most common application is to displace utility supplied power when sun is available.	High ($6,000 to $20,000/kW)	§ No air emissions or water discharges § No CO_2 emissions
	Large-scale central PV facility ("PV Power Plants")	§ Central PV power generation		No	High ($6,000/kW)	§ No air emissions or water discharges § No CO2 emissions § Land availability and use restrictions will affect applicability
	End User-Sited Solar thermal	§ Residential, commercial and institutional hot water heating § Space heating § Boiler feedwater preheating		No, but hot water storage minimizes the need for supplemental fuel. Properly sized systems provide about 80% of hot water energy requirements.	Moderate ($3,000 to $4,000 for a residential hot water system)	§ No air emissions or water discharges
Wind 	Wind turbines	§ Large-scale power generation for interconnection with transmission system § Small-scale off-grid and grid-interconnected residential and commercial systems.	Moderate to good resource available in coastal areas and Delaware Bay. Interior Delaware resource suitable only for small-scale turbines.	No	$1,000 to $1,500/kW on land for large turbines (>250 kW). Offshore costs depend on other factors. Small turbines in excess of $2,000/kW.	§ No air emissions or water discharges § No CO_2 emissions § Noise, visual impacts may be important siting issues § Impacts on bird populations may also be a siting issue

Resource	Utilization Technologies	Applications	Availability	Responsiveness to Demand	Cost	Environmental
Geothermal 	Ground source heat pumps	§ Residential and commercial space and water heating	Indirect form of solar energy; good resource available throughout the state.	Yes, heating or air conditioning is supplied on demand.	Varies depending on application	§ No emissions at point of use § Resource availability may be restricting by land area adjacent to building § Most efficient electric heating available. Emissions at power plant depend on regional fuel mix
Direct-Fired Biomass Wastes 	Solid-fueled stoves, furnaces and boilers	§ Best applications are commercial, institutional and industrial process, space heating and CHP where end-user is not far from point of waste production. § May also be co-fired in existing power boilers	Moderated to good in-state resource available based on studies. Regional resources also available, but not quantified.	Yes, as long as fuel is available.	Costs vary widely; primarily dependent on type of waste, costs of collection, transportation and processing.	§ Same considerations as direct fired biomass wastes § Land use for "energy plantations" may be a consideration. § CO_2 neutral when harvested sustainably
Direct-Fired Energy Crops 	Solid-fueled stoves, furnaces and boilers	§ Similar to biomass wastes, but best applications may be co-firing in existing power boilers if close to the point of production.	Moderate to good in-state resource available based on studies; includes switchgrasses and fast-growing hybrid woody plants. Regional resources also available, but not quantified.	Yes, as long as fuel is available.	Costs vary widely; primarily dependent on the cost of growing harvesting, transportation and processing.	§ Same considerations as direct fired biomass wastes § Land use for "energy plantations" may be a consideration. § CO_2 neutral when harvested sustainably

Resource	Utilization Technologies	Applications	Availability	Responsiveness to Demand	Cost	Environmental
Biofuels 	Conventional furnaces, boilers and IC engines	§ Bio-diesel for use in space heating, process heat, CHP, transportation and power generation. § Ethanol for gasoline supplement.	Commodity feed stocks (e.g. soybeans, corn, etc.) widely available throughout the region. Not state limited	Yes, as long as fuel is available.	Cost is mainly for development of bio-fuels processing plants	§ Same considerations as direct fired biomass wastes § Land use for "energy plantations" may be a consideration. § CO_2 neutral when harvested sustainably
Landfill Gas 	Conventional furnaces, boilers and IC engines	§ Power generation	Limited to DSWA landfills	Yes, as long as fuel is available.	Costs depend on costs of collecting and processing the gas on site	§ Utilization subject to permitting regulations governing air emissions from point sources for large projects § Reduces methane emissions substantially § Will eliminate emissions from existing flares § Power generation will slightly offset emissions from regional conventional power generation

Resource	Utilization Technologies	Applications	Availability	Responsiveness to Demand	Cost	Environmental
Fuel Cells 	Fuel Cells	§ Distributed power generation § Combined heat & power generation		Yes, as long as fuel is available	High: unsubsidized costs range from $4,500 to over $8,000 per kW	§ Virtually no criteria pollutant emissions on natural gas § High efficiency reduces global warming impact on fossil fuels § Emissions are water only when using hydrogen
Small Scale Hydro 	Small hydro turbines	§ Power generation	No formal assessment done, but small applications would probably be limited to northern areas of State due to topography	No. Small hydro is typically subject to stream flow variations	Highly variable	§ No air or water emissions, although aquatic habitats may be affected.
Ocean Energy 	Tidal (mechanical) energy conversion and thermal conversion	§ Power generation	No formal assessment done, but potentially significant	Tidal conversion is subject to daily and seasonal variation in tidal levels; thermal conversion is potentially demand responsive.	Not known, expected to be highly variable.	§ No air or water emissions, although aquatic habitats may be affected.

Source: Reproduced from Delaware Energy Task Force, 2003

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