Department of Regulatory Agencies

Office of Policy, Research and Regulatory Reform

2008 Sunrise Review: Photovoltaic Solar Electric Installers

May 23, 2008

Consumer Protection

STATE OF COLORADO

DEPARTMENT OF REGULATORY AGENCIES
Office of the Executive Director

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Bill Ritter Jr.
Governor

May 23, 2008

Members of the Colorado General Assembly
c/o the Office of Legislative Legal Services
State Capitol Building
Denver, Colorado 80203

Dear Members of the General Assembly:

The mission of the Department of Regulatory Agencies (DORA) is consumer protection. As a part of the Executive Director's Office within DORA, the Office of Policy, Research and Regulatory Reform seeks to fulfill its statutorily mandated responsibility to conduct sunrise reviews with a focus on protecting the health, safety and welfare of all Coloradans.

DORA has completed its evaluation of the sunrise application for regulation of Photovoltaic Solar Electric Installers and is pleased to submit this written report. The report is submitted pursuant to section 24-34-104.1, Colorado Revised Statutes, which provides that DORA shall conduct an analysis and evaluation of proposed regulation to determine whether the public needs, and would benefit from, the regulation.

The report discusses the question of whether there is a need for regulation in order to protect the public from potential harm, whether regulation would serve to mitigate the potential harm, and whether the public can be adequately protected by other means in a more cost-effective manner.

Sincerely,

D. Rico Munn
Executive Director

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The Sunrise Process

Background

Regulation, when appropriate, can serve as a bulwark of consumer protection. Regulatory programs can be designed to impact individual professionals, businesses or both.

As regulatory programs relate to individual professionals, such programs typically entail the establishment of minimum standards for initial entry and continued participation in a given profession or occupation. This serves to protect the public from incompetent practitioners. Similarly, such programs provide a vehicle for limiting or removing from practice those practitioners deemed to have harmed the public.

From a practitioner perspective, regulation can lead to increased prestige and higher income. Accordingly, regulatory programs are often championed by those who will be the subject of regulation.

On the other hand, by erecting barriers to entry into a given profession or occupation, even when justified, regulation can serve to restrict the supply of practitioners. This not only limits consumer choice, but can also lead to an increase in the cost of services.

There are also several levels of regulation. Licensure is the most restrictive form of regulation, yet it provides the greatest level of public protection. Licensing programs typically involve the completion of a prescribed educational program (usually college level or higher) and the passage of an examination that is designed to measure a minimal level of competency. These types of programs usually entail title protection – only those individuals who are properly licensed may use a particular title(s) – and practice exclusivity – only those individuals who are properly licensed may engage in the particular practice. While these requirements can be viewed as barriers to entry, they also afford the highest level of consumer protection in that they ensure that only those who are deemed competent may practice and the public is alerted to those who may practice by the title(s) used.

Certification programs offer a level of consumer protection similar to licensing programs, but the barriers to entry are generally lower. The required educational program may be more vocational in nature, but the required examination should still measure a minimal level of competency. Additionally, certification programs typically involve a non-governmental entity that establishes the training requirements and owns and administers the examination. State certification is made conditional upon the individual practitioner obtaining and maintaining the relevant private credential. These types of programs also usually entail title protection and practice exclusivity.

While the aforementioned requirements can still be viewed as barriers to entry, they afford a level of consumer protection that is lower than a licensing program. They ensure that only those who are deemed competent may practice and the public is alerted to those who may practice by the title(s) used.

Registration programs can serve to protect the public with minimal barriers to entry. A typical registration program involves an individual satisfying certain prescribed requirements – typically non-practice related items, such as insurance or the use of a disclosure form – and the state, in turn, placing that individual on the pertinent registry. These types of programs can entail title protection and practice exclusivity. Since the barriers to entry in registration programs are relatively low, registration programs are generally best suited to those professions and occupations where the risk of public harm is relatively low, but nevertheless present. In short, registration programs serve to notify the state of which individuals are engaging in the relevant practice and to notify the public of those who may practice by the title(s) used.

Finally, title protection programs represent one of the lowest levels of regulation. Only those who satisfy certain prescribed requirements may use the relevant prescribed title(s). Practitioners need not register or otherwise notify the state that they are engaging in the relevant practice, and practice exclusivity does not attach. In other words, anyone may engage in the particular practice, but only those who satisfy the prescribed requirements may use the enumerated title(s). This serves to indirectly ensure a minimal level of competency – depending upon the prescribed preconditions for use of the protected title(s) – and the public is alerted to the qualifications of those who may use the particular title(s).

Licensing, certification and registration programs also typically involve some kind of mechanism for removing individuals from practice when such individuals engage in enumerated proscribed activities. This is generally not the case with title protection programs.

As regulatory programs relate to businesses, they can enhance public protection, promote stability and preserve profitability. But they can also reduce competition and place administrative burdens on the regulated businesses.

Regulatory programs that address businesses can involve certain capital, bookkeeping and other recordkeeping requirements that are meant to ensure financial solvency and responsibility, as well as accountability. Initially, these requirements may serve as barriers to entry, thereby limiting competition. On an ongoing basis, the cost of complying with these requirements may lead to greater administrative costs for the regulated entity, which costs are ultimately passed on to consumers.

Many programs that regulate businesses involve examinations and audits of finances and other records, which are intended to ensure that the relevant businesses continue to comply with these initial requirements. Although intended to enhance public protection, these measures, too, involve costs of compliance.

Similarly, many regulated businesses may be subject to physical inspections to ensure compliance with health and safety standards.

Regulation, then, has many positive and potentially negative consequences. Colorado law, section 24-34-104.1, Colorado Revised Statutes (C.R.S.), requires that individuals or groups proposing legislation to regulate any occupation or profession first submit information to the Department of Regulatory Agencies (DORA) for the purposes of a sunrise review. The intent of the law is to impose regulation on occupations and professions only when it is necessary to protect the public health, safety or welfare. DORA must prepare a report evaluating the justification for regulation based upon the criteria contained in the sunrise statute:[1]

> (I) Whether the unregulated practice of the occupation or profession clearly harms or endangers the health, safety, or welfare of the public, and whether the potential for the harm is easily recognizable and not remote or dependent upon tenuous argument;
>
> (II) Whether the public needs, and can reasonably be expected to benefit from, an assurance of initial and continuing professional or occupational competence; and
>
> (III) Whether the public can be adequately protected by other means in a more cost-effective manner.

Any professional or occupational group or organization, any individual, or any other interested party may submit an application for the regulation of an unregulated occupation or profession. Applications must be accompanied by supporting signatures and must include a description of the proposed regulation and justification for such regulation.

Methodology

DORA has completed its evaluation of the proposal for regulation of Photovoltaic (PV) Solar Electric Installers. During the sunrise review process, DORA performed a literature search, contacted and interviewed the applicant, reviewed licensure laws in other states and conducted interviews of administrators of those programs. In order to determine the number and types of complaints filed against PV Solar Electric Installers in Colorado, DORA contacted representatives of the Denver/Boulder Better Business Bureau, the Office of the Attorney General Consumer Protection Section, members and staff of the Colorado Electrical Board, and the Governor's Energy Office. To better understand the practice of PV Solar Electric Installers, the author of this report visited two PV solar installation work sites.

[1] § 24-34-104.1(4)(b), C.R.S.

Profile of the Profession

According to the sunrise application submitted to the Department of Regulatory Agencies (DORA) by the Colorado Solar Energy Industries Association (Applicant), Photovoltaic (PV) Solar Electric Installers install solar electric systems for both commercial and residential use.

A PV solar electric system transforms sunlight to electricity by absorbing photons, which are small particles of energy made from sunlight. The electricity-producing portion of a PV solar electric system consists of three components:

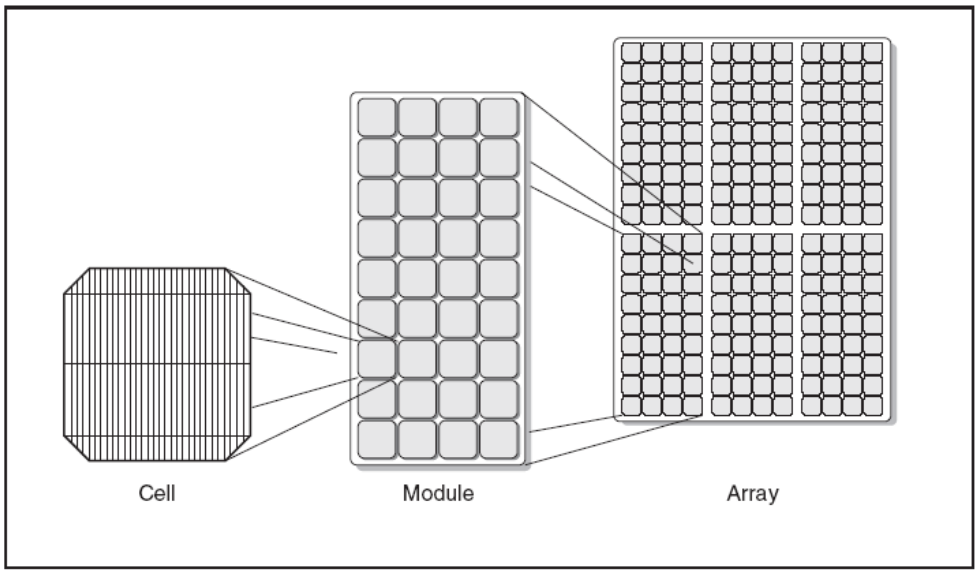
- Cells;
- Modules (panels); and
- Arrays.

Cells include semi-conducting materials, such as silicon, which absorb some photons and transform them to electrons.[2] The electrons are the electricity that flows through wires.[3]

Several individual cells are interconnected in a sealed, weatherproof package,[4] creating a module (panel). When two modules are wired in parallel, the combined unit's voltage is doubled while the current stays the same.[5]

To achieve the desired voltage and current, modules are wired, in parallel, into what is called an array. The following illustration highlights the three components that comprise the solar energy portion of a PV solar electric system. [6]

[2] Suntech – Guide to Solar Energy. *Solar FAQ: Solar energy and photovoltaics.* Retrieved April 28, 2008, from http://www.suntech-power.com/guide/solar_faq.php?print=y&
[3] Independent Power Systems. *Colorado FAQs.* Retrieved March 17, 2008, from http://www.solarips.com/colorado.php
[4] Renewable Energy. *Introduction to Photovoltaic Systems.* Retrieved April 29, 2008, from http://www.infinitepower.org/pdf/FactSheet-11.pdf
[5] Renewable Energy. *Introduction to Photovoltaic Systems.* Retrieved April 29, 2008, from http://www.infinitepower.org/pdf/FactSheet-11.pdf
[6] Renewable Energy. *Introduction to Photovoltaic Systems.* Retrieved April 29, 2008, from http://www.infinitepower.org/pdf/FactSheet-11.pdf



Photovoltaic cells, modules and arrays *The building blocks of solar electricity are modular in nature, allowing great flexibility in applications.*

The other components of a PV solar electric system include applicable electrical equipment (e.g., grounding wire, etc.) and mounting components (e.g., bolts, mounting poles, etc.)

Installation of PV solar electric systems includes the following:

- Physically attaching panels to a structure;
- Direct current (DC) wiring from individual modules to the DC side of the inverter; and
- Wiring and grounding the PV solar electric system.

PV solar electric systems are typically mounted on roofs of buildings. To have a PV solar electric system installed on a roof, the property must have a reasonable amount of non-shaded, unobstructed roof space during the key sun hours of the day.[7] A southern orientation is ideal, but east-and west-facing roofs can still capture a portion of the power of a true south-facing roof.[8] In some instances, PV solar electric systems are installed on special ground or pole-mounted structures.[9]

[7] Xcel Energy. *Will a PV System Work With My Home?* Retrieved March 4, 2008, from http://www.xcelenergy.com/XLWEB/CDA/0,308,1-1-2_735_25709_25677-23104-2_171_258-0,00.html

[8] Xcel Energy. *Will a PV System Work With My Home?* Retrieved March 4, 2008, from http://www.xcelenergy.com/XLWEB/CDA/0,308,1-1-2_735_25709_25677-23104-2_171_258-0,00.html

[9] Big Frog Mountain. *Today's Solar Electric Cells are a Practical and Environmentally Friendly Way of Producing Electricity for Everyday Use.* Retrieved May 4, 2008, from http://www.bigfrogmountain.com/research.htm

PV solar electric systems produce DC voltage. Most household appliances are designed to run on standard 120 volts of alternating current (AC) rather than DC power. In order to convert the DC power that is generated from the PV solar electric system into AC power, the PV solar electric system must have an inverter. An inverter is the device used to change solar electricity (DC volts) into regular household AC current.[10]

PV Solar Electric Installers must also know the proper grounding guidelines of a PV solar electric system, as well as other electrical functions, which are outlined in the National Electrical Code (NEC). The NEC outlines standard practices for the proper installation of PV solar electric systems. This information is contained throughout the NEC Handbook, but specifically in the first four chapters and article 690 – Solar Photovoltaic Systems.

Currently, there are three different types of PV solar electric systems: grid-tied, stand-alone and hybrid. In Colorado, all grid-tied (connected to the utility electric system) PV solar electric systems are connected to the power grid via a "net meter."[11] A net meter is a utility meter that will run backward if a consumer's production of energy is greater than his or her consumption.[12] If this occurs, the consumer sells the excess electricity to the electric utility at the current retail rates (the cost at which the electric utility sells the electricity to other consumers).

PV solar electric systems are also designed and installed as stand-alone systems. A stand-alone PV solar electric system relies on batteries to store the electricity generated. The batteries best suited for use with PV solar electric systems are called secondary or deep cycle batteries.[13] There are two types of deep cycle batteries: lead acid, which require the periodic addition of water, and captive electrolyte (or gelcell) batteries, which are maintenance free.[14]

Consumers can also choose to install a hybrid PV solar electric system. A hybrid PV solar electric system can utilize both the power grid as well as a battery. Hybrid PV solar electric systems benefit from the net metering function of being tied to the power grid, but also have the convenience of maintaining a battery in the event of a power outage. If a PV solar electric system is only grid-tied and the area experiences a power outage, the consumer will not be able to utilize electricity without a battery storage back-up.

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[10] Big Frog Mountain. *Today's Solar Electric Cells are a Practical and Environmentally Friendly Way of Producing Electricity for Everyday Use.* Retrieved May 4, 2008, from http://www.bigfrogmountain.com/research.htm

[11] Independent Power Systems. *Colorado FAQs.* Retrieved March 17, 2008, from http://www.solarips.com/colorado.php

[12] Independent Power Systems. *Colorado FAQs.* Retrieved March 17, 2008, from http://www.solarips.com/colorado.php

[13] Renewable Energy. *Introduction to Photovoltaic Systems.* Retrieved April 29, 2008, from http://www.infinitepower.org/pdf/FactSheet-11.pdf

[14] Renewable Energy. *Introduction to Photovoltaic Systems.* Retrieved April 29, 2008, from http://www.infinitepower.org/pdf/FactSheet-11.pdf

Additionally, Amendment 37 was passed by Colorado voters in November 2004. Amendment 37 mandated that utilities with more than 40,000 customers generate or purchase 10 percent of their electricity from renewable sources by 2015.[15] This target was subsequently increased by House Bill 07-1281 (HB 1281) to 20 percent by 2020.

As a result of the requirements imposed by both Amendment 37 and HB 1281, a number of utilities are currently offering incentives to consumers. Given these incentives and the rising cost of energy in general, it is reasonable to expect the demand for renewable energy programs to continue to increase.

PV Solar Electric System Installation Process

The general step-by-step process for installing a PV solar electric system (both residential and commercial) is as follows:

- The consumer seeks information on a PV solar electric system;
- The consumer identifies a PV solar electric system contractor by consulting a number of various sources, including the Internet, yellow pages or referrals, etc.;
- The consumer initiates contact with the PV solar electric system contractor;
- The contractor may request past utility bills (usually a one year billing cycle) in order to determine past electricity usage, which assists the contractor and the consumer in determining the size of the PV solar electric system;
- The contractor schedules a site visit to assess whether the home or business has adequate space to accommodate a PV solar electric system either on the roof or on the ground through a pole-mounted system;
- The contractor also assesses the logistics of integrating into the power grid connection (or house power if it is an off-grid system);
- The contractor creates a proposal which usually includes: total cost, potential applicable rebates/credits and technical information including estimated production and equipment used;
- The consumer and the contractor agree on a price and times for completion of installation of the PV solar electric system;
- The contractor finalizes the design and logistics of the PV solar electric system;
- The contractor applies for an electrical permit and a structural permit (if required) and initiates the Xcel or other utility rebate process via an online application (or other rebates, if applicable);
- The contractor may require a deposit as part of the consumer/contractor agreement;

[15] Solar Power Authority. *Colorado Solar Energy Resources.* Retrieved on May 3, 2008, from http://www.solarpowerauthority.com/colorado/

- The contractor begins the installation process (e.g., attaching solar panels, wiring, etc.);
- The contractor requests the final inspection from the local government (or state inspectors if a state electrical permit is issued) once installation is complete;
- The inspection is performed and the installation is either approved by the inspector, or deficiencies are noted and ordered repaired;
- Once the deficiencies have been repaired and inspected, the installation is approved by the inspector;
- The inspection report and permit are mailed to the utility and a work order is generated for the installation of the bi-directional net meter, which will allow the utility to accurately track the power consumption/excess (if the PV solar electric system is not tied to the power grid, a bi-directional meter is not necessary);
- The utility dispatches personnel to install the bi-directional meter. Utility personnel will conduct a cursory inspection of the system prior to actual installation of the new meter. If anything appears to be out of the ordinary, utility personnel may halt the process until deficiencies are corrected;
- The contractor energizes the PV solar electric system, completing the installation; and
- The consumer receives a warranty and paperwork records for the PV solar electric system.

Additionally, the North American Board of Certified Energy Practitioners (NABCEP) and the Colorado Solar Energy Industries Association (CoSEIA) offer certification programs related to PV Solar Electric Installers.

NABCEP Certifications

NABCEP is a professional credentialing organization dedicated to implementing appropriate professional standards designed to protect consumers and the PV profession.[16] NABCEP offers a PV Solar Installer certification and an Entry Level Certificate of Knowledge. According to the NABCEP website, there are 31 NABCEP certified PV Solar Installers in Colorado.

[16] North American Board of Certified Energy Practitioners. *Photovoltaic Entry Level Certificate of Knowledge.* Retrieved May 2, 2008, from http://www.nabcep.org/Monticello/userfiles/File/EntryLevelCertificateProviderOverviewOct07.pdf

In order to receive a PV Solar Installer certification though NABCEP, a candidate must pass an examination. The examination consists of 60 multiple-choice questions in the following content areas:[17]

- Working safely with PV solar electric systems;
- Conducting a site assessment;
- Selecting a PV solar electric system design;
- Adapting the mechanical design;
- Adapting the electrical design;
- Installing subsystems and components at the site;
- Performing a system checkout and inspection; and
- Maintaining and troubleshooting a PV solar electric system.

Additionally, a candidate must meet one of the following training and experience requirements to be eligible to receive the PV Solar Installer certification:[18]

- Four years of experience installing PV solar electric systems;
- Two years of experience installing PV solar electric systems in addition to completion of a NABCEP-recognized training program;
- Be an existing licensed contractor in good standing in solar or electrical construction-related areas with one year experience installing PV solar electric systems;
- Four years of electrical construction-related experience working for a licensed contractor, including one year of experience installing PV solar electric systems;
- Three years experience in a United States Department of Labor-related electrical construction trade apprentice program, including one year of experience installing PV solar electric systems;
- Two-year electrical construction-related, or electrical engineering technology, or renewable energy technology/technician degree from an educational institution plus one year of experience installing PV solar electric systems; or
- Four-year construction-related engineering degree from an educational institution, including one year of experience installing PV solar electric systems.

[17] North American Board of Certified Energy Practitioners. *Candidate Information Handbook.* Retrieved on April 28, 2008, from http://www.nabcep.org/Monticello/userfiles/File/PV%20Candidate%20Handbook%20April%202008.pdf

[18] North American Board of Certified Energy Practitioners. *Candidate Information Handbook.* Retrieved on April 28, 2008, from http://www.nabcep.org/Monticello/userfiles/File/PV%20Candidate%20Handbook%20April%202008.pdf

Currently, NABCEP charges a $50 application fee and $200 to take the PV Solar Installer certification examination. NABCEP charges $150 to re-take the PV Solar Installer certification examination if a candidate does not pass the first time. NABCEP also requires a $200 recertification fee once a candidate receives certification.

The Entry Level Certificate of Knowledge is offered by NABCEP for students who are interested in PV solar electric installation. Achieving a certification is a two step process. First, a candidate must successfully complete a course(s) during a semester or other defined time period and then take a NABCEP-issued examination.[19] According to information obtained from the NABCEP website, there is one location offering this training in Colorado: the Denver Joint Electrical Apprenticeship and Training Committee. Second, a candidate must pass a NABCEP-issued examination.

The examination consists of 60 multiple-choice questions related to basic knowledge of PV solar electric systems. NABCEP charges $70 to take the Entry Level Certificate of Knowledge examination.

The Entry Level Certificate of Knowledge does not qualify an individual to install PV solar electric systems; however, it does recognize that a candidate understands the basic terms and operational aspects of a PV solar electric system.[20] This certification serves as an instrument to obtain entry level knowledge of the PV solar electric system installation field.

CoSEIA Certifications

CoSEIA represents and serves energy professionals and renewable energy users, and promotes the use of solar energy and conservation to improve the environment and create a sustainable future.[21] According to information provided by the Applicant, there are 29 CoSEIA certified PV Solar Electric Installers in Colorado.

In order to obtain certification through CoSEIA, a candidate must pass an examination and have experience installing PV solar electric systems. The examination consists of 86 multiple-choice questions and must be completed in two hours. A candidate must answer more than 80 percent of the questions correctly to receive a passing grade.

[19] North American Board of Certified Energy Practitioners. *Photovoltaic (PV) Entry Level Certificate of Knowledge.* Retrieved May 2, 2008, from http://www.nabcep.org/Monticello/userfiles/File/EntryLevelCertificateProviderOverviewOct07.pdf
[20] North American Board of Certified Energy Practitioners. *Photovoltaic (PV) Entry Level Certificate of Knowledge.* Retrieved May 2, 2008, from http://www.nabcep.org/Monticello/userfiles/File/EntryLevelCertificateProviderOverviewOct07.pdf
[21] Colorado Solar Energy Industries Association. *About CoSEIA.* Retrieved May 2, 2008, from http://www.CoSEIA.org/AboutCoSEIA.html

The experience required for installing PV solar electric systems is as follows:

- Minimum of two PV solar electric systems totaling one kilowatt, each system must have an inverter, one of which must have a two kilowatt inverter minimum, and both of which must have been completed within the past year;
- Two PV solar electric system upgrades totaling one kilowatt can be applied and count as one system; and
- Each PV solar electric system installed must have received an electrical permit and the appropriate documentation must be provided.

CoSEIA members are charged $100 for the application fee, which covers the validation of experience and the initial written examination. Non-members are charged $200 for the application fee. Also, a member may retake the written examination (after the required four-month waiting period) for $50, while non-members are charged $100.

Proposal for Regulation

The Colorado Solar Energy Industries Association (Applicant) has submitted a sunrise application to the Department of Regulatory Agencies (DORA) for review in accordance with the provisions of section 24-34-104.1, Colorado Revised Statutes (C.R.S.). The application identifies state licensure of Photovoltaic (PV) Solar Electric Installers as the appropriate level of regulation to protect the public.

Licensure typically entails a demonstration of competency in order to practice in a specified profession or occupation. The sunrise application details the minimum competencies necessary to operate as PV Solar Electric Installers as:

- Knowledge of the National Electrical Code – Article 690 (Solar Photovoltaic Systems); and
- Knowledge of the design, installation and safety of PV solar electric systems.

Also, according to the sunrise application, licensure of PV Solar Electric Installers would:

- Raise standards and maintain the highest quality and safety practices possible in the PV solar electric industry, ensuring Colorado as a national leader in the new energy economy;
- Protect the consumer;
- Increase the safety and longevity of the industry;
- Implement and regulate statewide standards; and
- Regulate quality and safety measures for the state.

Additionally, the Applicant outlines several types of harm that could potentially occur in the absence of regulation of PV Solar Electric Installers, including:

- Installing PV solar electric systems improperly causing physical harm (e.g., shock from incorrect grounding);
- Installing solar panels in shady areas – which could cause financial harm;
- Back-feeding electrical current through sensitive equipment and/or the power grid; or
- Improperly designed and/or installed PV solar electric systems causing:
    - Roof leaks; and
    - Water intrusion.

Specific examples of harm to the public are discussed in detail in the Analysis and Recommendations Section of this report.

Summary of Current Regulation

The Colorado Regulatory Environment

Federal Regulations

The Energy Policy Act (EPACT), which was enacted in 2005, offers consumers and businesses federal tax credits beginning in January 2006 for purchasing fuel-efficient hybrid-electric vehicles and energy-efficient appliances and products,[22] including Photovoltaic (PV) solar electric systems. Specifically, EPACT provides a 30 percent tax credit on residential PV solar electric systems based on the total cost of the PV solar electric system after other rebates and incentives have been deducted.[23] The tax credit allowed for residences under EPACT is capped at $2,000.

For commercial PV solar electric systems, EPACT provides a 30 percent tax credit on the total cost of the PV solar electric system before the other incentives are factored in and there is no cap.[24]

State Regulations

Although PV Solar Electric Installers are not regulated in Colorado, some stakeholders argue that PV solar electric system installation falls under the electricians scope of practice. Thus, these stakeholders see no need for new regulation. In order to understand the relationship between PV solar electric system installation and the work of licensed electricians, a summary of the licensing requirements and the scope of practice of licensed electricians in Colorado follows.

Electricians are regulated by the State Electrical Board (Board). The Board is made up of nine members consisting of two electrical contractors who have master's licenses; two master or journeyman electricians who are not electrical contractors; two representatives of private, municipal, or cooperative electrical utilities rendering electric service to the public; one building official from a political subdivision of the state that performs electrical inspections; one general contractor from the building industry; and one public member. The Board is located in the Colorado Department of Regulatory Agencies, Division of Registrations.

[22] U.S. Department of Energy. *The Energy Policy Act of 2005.* Retrieved May 2, 2008, from http://www.energy.gov/taxbreaks.htm

[23] Namaste Solar Electric. *Rebates & Incentives.* Retrieved on March 17, 2008, from http://www.namastesolar.com/amendment.htm

[24] Namaste Solar Electric. *Rebates & Incentives.* Retrieved on March 17, 2008, from http://www.namastesolar.com/amendment.htm

A master electrician is an electrician that is authorized to plan, layout, and supervise the installation of wiring apparatus and equipment for electric light, heat, power and other purposes in accordance with rules and regulations such as the National Electrical Code (NEC). A master electrician must be 1) a graduate electrical engineer and have one year of practical electrical experience in the construction industry, or 2) a graduate of an electrical trade school or community college with at least four years of practical experience in electrical work, or 3) have at least one year of practical experience in planning, laying out, supervising, and installing wiring, apparatus, or equipment for electrical light, heat, and power beyond the practical experience requirements for the journeyman's license.

The journeyman electrician is authorized to wire for, install, and repair electrical apparatus and equipment for light, heat, power, and other purposes in accordance with standard rules and regulations governing said work. A journeyman electrician must have completed at least a four-year apprenticeship in the electrical trade or have four years of practical experience in wiring, installing, and repairing electrical apparatus and equipment for light, heat and power. In addition, two of the four years experience must be in commercial, industrial, or substantially similar work.

A residential wireman is authorized to wire for, and install, electrical apparatus and equipment for wiring one, two, three, and four family dwellings. A residential wireman must have at least two years of accredited training or two years of practical experience in wiring one, two, three, and four family dwellings.

Again, although no statute or Board rule explicitly requires PV Solar Electric Installers to be licensed electricians, it is unclear whether the Board has the authority to assert its jurisdiction, either through rule or otherwise, over PV Solar Electric Installers.

Local Regulations

Most local governments require an electrical permit prior to the installation of a PV solar electric system. The permit requires an inspection of the PV solar electric system by local authorities. The permitting process ensures that a PV solar electric system is installed to the specifications outlined in the NEC, as well as any applicable local ordinances. In the event that a local government does not have a permitting process in place, State of Colorado electrical inspectors inspect PV solar electric systems to ensure they meet applicable safety standards.

Many local governments also require that a structural permit be obtained prior to installing a PV solar electric system. The structural permit ensures that the installation of a PV solar electric system meets the current load standards (e.g., a truss can withstand the load of a PV solar electric system).

Regulation in Other States

At least eight states regulate PV Solar Electric Installers. The eight states are:

- Arizona;
- California;
- Connecticut;
- Florida;
- Hawaii;
- Nevada;
- Oregon; and
- Utah.

The State of Arizona offers a Solar-Electric Installations Only license. This license has reduced technical testing (and all of the normal general contracting law testing).[25] This license allows installation of the entire PV solar electric system and connection to the nearest appropriate electrical panel.[26] In order to receive a license to install PV solar electric systems in Arizona, a candidate must demonstrate that he or she has a minimum of four years of relevant work experience.

The State of California offers a Solar Contractor license that encompasses a variety of solar installations, including PV solar electric systems. In order to receive a Solar Contractor license in California, a person must pass an examination and provide documentation that he or she possesses a minimum of four years relevant work experience related to PV solar electric systems.

The State of Connecticut offers two licenses related to PV solar electric systems: Limited Solar Electric Contractor and Limited Solar Electric Journeyperson. The first, the Limited Solar Electric Contractor license, enables the person who possesses the license to perform solar electricity work.[27] To qualify for a Limited Solar Electric Contractor license, a person must have a minimum of two years of experience as a Limited Solar Electric Journeyperson or equivalent experience and training.[28]

[25] DSIRE. *Solar Contractor Licensing.* Retrieved on March 17, 2008, from http://dsireuse.org/library/includes/printincentive.cfm?incentive_code=AZ02R
[26] DSIRE. *Solar Contractor Licensing.* Retrieved on March 17, 2008, from http://dsireuse.org/library/includes/printincentive.cfm?incentive_code=AZ02R
[27] DSIRE. *Solar and Wind Contractor Licensing and Training.* Retrieved on March 17, 2008, from http://dsireuse.org/library/includes/printincentive.cfm?incentive_code=CT02R
[28] DSIRE. *Solar and Wind Contractor Licensing and Training.* Retrieved on March 17, 2008, from http://dsireuse.org/library/includes/printincentive.cfm?incentive_code=CT02R

In Connecticut, a licensed Limited Solar Electric Journeyperson may perform electrical work only while in the employ of a licensed contactor.[29]

The State of Florida requires a candidate to obtain a Solar Contractor license prior to installing PV solar electric systems. To qualify for a Solar Contractor license, PV Solar Electric Installers are required to have four years experience, which may include installation and education and at least one year of experience supervising.[30] A candidate must also pass an examination prior to obtaining a Solar Contractor license.

The State of Hawaii requires specialty licenses for solar contractors. Specifically, a person may obtain a Solar Power Systems Contractor license, by passing an examination and possessing four years of experience, to install PV solar electric systems related to low voltage (less than 50 volts) direct current (DC) wiring; however, a licensed electrician license is required for the installation of PV solar electric systems other than low voltage DC wiring.[31] Hawaii also requires a licensed electrician to certify that a PV solar electric system (other than low voltage DC wiring) and its connections have been properly installed.

The State of Nevada requires a person to obtain a PV Solar Installer license prior to installing and maintaining PV solar electric systems. To possess a PV Solar Installer license, a person is required to pass an examination and pay applicable fees.

The State of Oregon allows electrical contractors to install renewable energy systems, including PV solar electric systems. Oregon also offers an Electrical Contractor, Renewable Energy, Limited license that allows the holder to install, maintain, replace or repair electrical wiring on PV solar electric systems that do not exceed 25 kilovolt-amps. To obtain the Electrical Contractor, Renewable Energy, Limited license a candidate must serve two years as an apprentice and pass an examination.

The State of Oregon also created an apprenticeship program related to PV Solar Electric Installers, called the Limited Renewable Energy Technician program. The apprenticeship program is intended to provide practical experience in the installation of PV solar electric systems.

The State of Utah offers a Solar Energy Systems Contractor license to install PV solar electric systems. In order to obtain a license, a candidate must possess two years of experience and pass an examination.

While conducting this review, DORA was unable to determine if regulation in these states has increased public safety.

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[29] DSIRE. *Solar and Wind Contractor Licensing and Training.* Retrieved on March 17, 2008, from http://dsireuse.org/library/includes/printincentive.cfm?incentive_code=CT02R

[30] DSIRE. *Solar Contractor Licensing.* Retrieved on March 17, 2008, from http://dsireuse.org/library/includes/printincentive.cfm?incentive_code=FL02R

[31] DSIRE. *Solar Contractor Licensing.* Retrieved on March 17, 2008, from http://dsireuse.org/library/includes/printincentive.cfm?incentive_code=HI03R

Analysis and Recommendations

Public Harm

The first sunrise criterion asks:

> Whether the unregulated practice of the occupation or profession clearly harms or endangers the health, safety or welfare of the public, and whether the potential for harm is easily recognizable and not remote or dependent on tenuous argument.

Before moving forward in the analysis of the harm caused by the unregulated practice of installing photovoltaic (PV) solar electric systems, it is important to identify what constitutes harm to the public (both residents and businesses) that purchases PV solar electric systems. The incorrect installation of a PV solar electric system could impose financial harm to the consumer due to the fact that the PV solar electric system was purchased and is not producing electricity. Also, the improper installation (e.g., installing a PV solar electric system in a shady area) could prevent the PV solar electric system from optimal performance, which could contribute to financial harm.

Additionally, the consumer could incur physical harm from an improperly installed PV solar electric system. The physical array could be inadequately secured, thereby causing it to fall from a roof and injuring someone. Additionally, a PV solar electric system could be improperly wired or grounded, which could leave the consumer vulnerable to electrical shock, fire or in the worst case scenario, death.

In order to determine whether the public is vulnerable to incompetent installations of PV solar electric systems, the Department of Regulatory Agencies (DORA) requested specific examples of harm to the public from the Colorado Solar Energy Industries Association (Applicant). The Applicant provided a number of examples of what it believes is happening in the PV solar electric system field. The examples of harm provided by the Applicant may be found in Appendix A on page 24. The examples highlighted in Appendix A are not specific instances, but instead are generalizations illustrating poor practices in the PV solar electric system installation field.

Also, the examples provided do not delineate when or where the examples happened; therefore, it is impossible to determine whether the examples are currently affecting Colorado consumers.

In addition to the information in Appendix A, the Applicant submitted two examples of harm caused by PV solar electric system installation contractors. In the first example, the complaint alleges that the PV solar electric system contractor improperly installed a PV solar electric system. The consumer explains that he did not pursue legal action. The complaint continues to allege that the company extracted money from his credit card.

Information provided by the consumer indicates that the PV solar electric system contractor and the consumer share the responsibility of the improperly installed PV solar electric system. The consumer explained that the contractor told the consumer that his roof was not conducive to the installation of a PV solar electric system. The consumer stated that he wanted it installed on the roof anyway. The PV solar electric system was installed on the roof without obtaining a local government permit. There appeared to be confusion as to who was responsible for obtaining a permit; but a permit was clearly required.

In the end, the PV solar electric system installation contractor and the consumer agreed to a financial agreement for the work completed.

The consumer could also have pursued legal action against the PV solar electric system installation contractor for allegedly stealing money by using his credit card; however, according to the consumer, both the PV solar electric system contractor and the consumer reached an agreement on when and how much would be repaid.

The second example of harm submitted by the Applicant is related to an off-grid PV solar electric system in Hartsel, Colorado. In this example, a family purchased an off-grid PV solar electric system in 1997, and it was installed in a subpar fashion. As a result, the family, according to information provided by the Applicant, spent more than $50,000 to get its PV solar electric system operational.

DORA contacted the family in an attempt to gain a better understanding of its poor experience. The family stated that neither it nor the PV Solar Electric Installer obtained an electrical permit prior to installation of the PV solar electric system. Consequently, the system did not receive an electrical inspection to ensure proper installation of the system. Securing an electrical permit prior to the installation of the PV solar electric system could have prevented the substantial extra costs that the family incurred in order to get the PV solar electric system operational.

During the course of this sunrise review, DORA contacted staff within the Division of Registrations (Division) and requested information related to complaints filed with the State Electrical Board (Board) related to the installation of PV solar electric systems. Division staff indicated that two complaints had been filed with the Board in the past five years.

One of the complaints was initiated because a PV Solar Electric Installer, not a licensed electrician, failed to correct National Electrical Code (NEC) violations identified during an inspection by a municipal code inspector. Division staff indicated that the Board issued a citation against the PV Solar Electric Installer for $300.

The second violation filed with the Board was due to the fact that a PV Solar Electric Installer, not a licensed electrician, failed to secure an electrical permit from the municipality from which the PV solar electric system was installed. Division staff stated that the Board issued a citation to the PV Solar Electric Installer for $250.

Both of the complaints provided by Division staff illustrate that the complaints are not errors related to competency. Rather, the complaints are attributable to failure to adhere to administrative requirements.

During this sunrise review, DORA was unable to secure a definitive answer to the question as to whether the Board has jurisdiction over PV Solar Electric Installers. According to interviews with senior staff of the Board, there is a belief that persons installing solar systems are performing the work of licensed electricians and are therefore under the jurisdiction of the Board. However, where or when electrical work is taking place is not clearly defined by statute. Thus, there is on-going debate around this issue.

DORA also contacted the Attorney General Consumer Protection Section (AGO) in an attempt to identify additional harm. Staff within the AGO highlighted 10 complaints since 2003 related to PV solar electric systems.

Five of the 10 complaints reported to DORA by the AGO were related to dealers selling PV equipment, not installation issues.

One of the complaints addressed issues with a manufacturer of PV solar electric systems, not installation issues.

The four remaining complaints received by the AGO related to PV solar electric systems appear to be related to service and repair. DORA requested additional information from staff within the AGO in an attempt to conduct a comprehensive analysis on the four complaints. However, DORA was informed by the AGO staff that the four remaining cases have been forwarded to the Denver/Boulder Better Business Bureau (BBB) for mediation, and staff is unable to provide additional information about the complaints; the files have been closed.

Finally, DORA contacted the BBB. However, the BBB staff indicated that no complaints had been filed in the past five years.

According to information provided by the Applicant, Xcel Energy has connected approximately 1,000 PV solar systems to its power grid in a little more than one and a half years in Colorado. Although Xcel Energy is not the only electric utility offering rebates to consumers who install PV solar energy systems, it has the largest consumer base and the most participants in the rebate program.

Given the large number of PV solar electric system installations in Colorado, there is evidence of relatively few consumer complaints, as illustrated in the small number of examples of harm identified during this sunrise review.

The limited number of consumer complaints calls into question the need for state regulation of PV Solar Electric Installers. Reviewing the small number of consumer complaints indicates that PV solar electric systems are, by and large, installed correctly. Additionally, if there are issues with violations of the NEC code or local building codes, municipal and state electrical inspectors are equipped to identify the violations. This is further illustrated in the sunrise application (on page 6) in which the Applicant states that some of the harm to consumers is alleviated through the permitting process. Therefore, effective regulation to ensure PV solar electric systems are installed properly already exists through the local government permitting process.

The lack of evidence of harm to the public, as well as the current permitting and inspection process already in place, calls into question the need for state regulation of PV Solar Electric Installers.

Need for Regulation

The second sunrise criterion asks:

> Whether the public needs and can reasonably be expected to benefit from an assurance of initial and continuing professional or occupational competence.

This criterion addresses the proposition of whether the state should require a certain level of education and/or impose a requirement that PV Solar Electric Installers pass an examination before being licensed to practice in Colorado. As outlined earlier in this report, the eight states that require licensure in order to install PV solar electric systems require a candidate to pass an examination prior to possessing a license.

No evidence has been presented during the course of this sunrise review to indicate that PV Solar Electric Installers lack the adequate skills, education and competencies necessary to practice safely.

According to information provided by the Applicant, in Colorado, approximately 20 percent of PV Solar Electric Installers voluntarily achieve certification through either the North American Board of Certified Electrical Practitioners (NABCEP) or CoSEIA. The 20 percent reflects a commitment to provide quality service to the public, and to continue to improve quality standards.

The lack of evidence identifying incompetency among PV Solar Electric Installers demonstrates that state regulation of PV Solar Electric Installers is not necessary.

Alternatives to Regulation

The third sunrise criterion asks:

> Whether the public can be adequately protected by other means in a more cost-effective manner.

Public protection could potentially be realized and enhanced in a variety of ways. First, the State of Colorado could require all PV Solar Electric Installers to obtain certification from either NABCEP or CoSEIA, the Applicant, in order to work as a PV Solar Electric Installer. The costs to the state would be minimal; however, requiring all PV Solar Electric Installers to obtain certification prior to working in Colorado could limit the number of PV Solar Electric Installers, while potentially increasing fees which they would charge.

The state could also require PV Solar Electric Installers to be licensed electricians. According to a representative of the Southwest Development Institute, New Mexico State University, in order to effectively install a PV solar electric system, a person must have knowledge of the majority of the first four chapters of the NEC, as well as other miscellaneous articles throughout the NEC, including article 690 – Solar Photovoltaic Systems. This knowledge base of the NEC is, in effect, the knowledge level an electrician possesses to effectively work in his or her field.

Requiring PV Solar Electric Installers to be licensed electricians could limit the number of PV Solar Electric Installers in Colorado. A licensed electrician possesses a broad array of skills related to the electrical field. By contrast, a PV solar electric system installer is a specialized scope of practice, whereby licensing in the entire electrical field of practice may not be necessary.

Neither alternative presented is justified for PV Solar Electric Installers due to the fact that there are low incidences of harm to the public.

Conclusion

The sunrise application submitted to DORA by the Applicant identified licensure as the appropriate level of regulation for PV Solar Electric Installers. The Applicant states that licensure would protect the public by oversight of the common practices and procedures of the trade. However, based on the sunrise criteria and the lack of evidence of public harm discovered through this review, no regulation is justified at this time.

During this sunrise review, DORA identified the following:

- A limited number of consumer complaints;
- A lack of evidence identifying incompetent practitioners; and
- A comprehensive local government permitting and inspection process that assists in identifying unsafe PV solar electric system installation issues.

According to information provided by the Applicant, Xcel Energy has connected approximately 1,000 PV solar systems to its power grid in a little more than one and a half years in Colorado. Due to the relatively low number of consumer complaints compared to the number of annual PV solar electric system installations, it is reasonable to conclude that there is not a widespread problem of inadequate installations of PV solar electric systems.

Additionally, licensure, as requested by the Applicant, is the most restrictive form of regulation and requires a demonstration of competency prior to obtaining a license to practice. Implementing a licensure program for PV Solar Electric Installers would erect an unnecessary barrier to entry since the sunrise review failed to demonstrate a lack of competency regarding PV solar electric system installations. In addition to the broad problems associated with unnecessary regulation, creating a barrier to entry could adversely affect the Governor's "new energy economy" by restricting the number of PV Solar Electric Installers in Colorado.

Further, local governments provide consumer protection by requiring PV Solar Electric Installers to obtain an electrical and a building (if applicable) permit prior to installation. This requirement serves to insulate the consumer from harm.

Upon obtaining a permit, local government staff inspects the installation of the PV solar electric system to ensure that the PV solar electric system meets the current electrical code and applicable municipal requirements. If a county or municipality does not have the capacity to complete an electrical inspection, the PV Solar Electric Installer is required to obtain a permit from the State Electrical Board. Consequently, each installation of a PV solar electric system includes a thorough process to ensure consumer protection (both financially and physically).

It should be noted that although the majority of local governments require a building (structural) permit prior to the installation of a PV solar electric system, some do not. If this is the case, there is not a department or division within state government that will complete a building inspection.

It is conceivable that the absence of a building permit could potentially leave the consumer vulnerable to harm (e.g., determining whether trusses on a building can hold the weight of the PV solar electric system); however, this sunrise review uncovered no evidence demonstrating harm to the consumer from the absence of a building permit. Therefore, it is reasonable to conclude that there are not widespread problems related to building permit issues in areas that do not require building permits for the installation of a PV solar electric system.

The Colorado General Assembly has historically taken a firm position that occupational regulation should only be imposed when there is clear evidence that consumers are harmed in the unregulated market. The evidence provided by the Applicant and additional evidence secured by DORA through research does not support creation of regulation at this time.

However, this report has pointed out that the PV solar electric system installation industry is very dynamic and incentives such as those enacted in Colorado should further increase demand. A review of the official publication of the International Association of Electrical Inspectors reveals numerous articles devoted to PV solar electric systems. It can be concluded from this increased focus that electrical inspectors see the need for increased awareness regarding the inspection of these systems, very likely a result of an increase in the number and type of PV solar electric systems installed and requiring inspection.

Whether the market can continue to protect consumers as demand increases bears close scrutiny by policy makers. Such market conditions are prime environments for fly-by-night businesses. While there is no evidence of this in Colorado presently, this may be due to the sophistication of consumers when purchasing an expensive product such as PV solar electric systems. Such dynamics can change quickly if demand increases rapidly.

In sum, the case has not been made that regulation of PV Solar Electric Installers is necessary in Colorado. Instead, the lack of harm to consumers, as well as the local government permit process, illustrate that there is an adequate level of regulation available to provide a high level of consumer protection.

Recommendation – Impose no regulation on Photovoltaic Solar Electric Installers in Colorado.

Appendix A – Examples of Harm Submitted by the Applicant to DORA

1. Failure to tighten down lug bolts on batteries causing premature failure of batteries due to under charging.

2. Failure to teach customers proper equalizing techniques causing inadequate charging leading to premature battery failure.

3. Failure to install DC Disconnect to allow safe removal of Inverter.

4. Improper grounding resulting in potential shock hazard at array.

5. Failure to provide for bonding of Ground across Inverter location when it is removed for service.

6. Lack of proper training for programming and operation causing much customer dissatisfaction in the Industry in general.

7. Giving customers too high of expectations on output of system in order to make the sale.

8. Wiring the AC Disconnect backwards making it unsafe for unknowing service person or electrician.

9. Connecting PV system against the NEC in Commercial Breaker Panel where the buss ends up loaded above its rating.

10. Designing a system where, at high radiance, the Voc exceeds 600 volts, which is against Code and would damage the Inverter.

11. Installing penetrations improperly in the roof, jeopardizing the integrity of the roof.

12. On a Grid Tied PV System, tying in between the meter and the Main Panel using non-code approved methods.