



**NABCEP® LAUNCHES PHOTOVOLTAIC (PV)
ENTRY LEVEL CERTIFICATE OF KNOWLEDGE
FOR STUDENTS**

Certificate Offers Instructors Opportunity to Participate in National Industry Program

Dear Educator:

The North American Board of Certified Energy Practitioners (NABCEP®), is pleased to offer the NABCEP® Photovoltaic (PV) Entry Level Certificate of Knowledge. This package will give you all of the information you need to become an organization to offer this Certificate to your students.

You may know that NABCEP® has an ANSI® accredited national certification program for PV Installers. This credential is a capstone designation based on professional experience and a rigorous application and written assessment process.

The Entry Level Certificate is for students wanting to get into the solar field and will be a way for them to show that they have achieved basic knowledge, comprehension and application of key terms and concepts of photovoltaic (solar electric) system operations. The certificate will demonstrate that the student has passed an industry-designed exam based on learning objectives developed by subject matter experts.

As the market grows for photovoltaics, students holding this industry-sponsored Entry Level Certificate could find that their employment opportunities are enhanced by starting the job with an understanding of the basic terms and operational aspects of a PV system. However, the Certificate by itself does not qualify an individual to install PV systems.

This package gives you more information about NABCEP®, reviews the guidelines and process for participation in this Certificate program, talks about the exam, includes the application, learning objectives and other forms.

If you have any questions about the criteria for offering this certificate to your students or the application, please call at (518) 899-8186 or email me at kchristopher@nabcep.org. You can also visit our web site at www.nabcep.org for more information about our certification programs including the listing of those who have achieved NABCEP certification for experienced PV installers.

**10 Hermes Road, Suite 400
Malta, NY 12020
Tele. (518) 899-8186
Fax. (518) 899-1092**

We hope that you will join with NABCEP® and offer your students the PV Entry Level Certificate of Knowledge. We feel this is a very good first step in getting more people involved in an exciting industry that is growing and bringing clean and indigenous energy to communities all across the county.

We look forward to hearing from you soon.

Sincerely,

Karen M. Christopher
Operations Manager

**10 Hermes Road, Suite 400
Malta, NY 12020
Tele. (518) 899-8186
Fax. (518) 899-1092**



North American Board of Certified Energy Practitioners

PHOTOVOLTAIC (PV) ENTRY LEVEL CERTIFICATE OF KNOWLEDGE

OVERVIEW, PROCESS & POLICIES

About NABCEP

The North American Board for Certified Energy Practitioners, Inc. (NABCEP) is a national voluntary, non-profit, professional credentialing organization lead by PV industry stakeholders. NABCEP certifies qualified practitioners in the fields of renewable and sustainable energy, and energy efficiency technologies, who have met the professional knowledge standards established by NABCEP. The purpose and goal of NABCEP is to assess and measure objectively the professional knowledge of renewable energy industry practitioners, and to promote the advancement of the renewable energy industry. NABCEP is dedicated to the implementation of appropriate professional standards designed to protect consumers and the profession.

Career Outlook

Photovoltaic devices generate electricity directly from sunlight. PV or solar electric systems can power small devices such as road signs, can be placed on rooftops for homes, businesses or schools, can provide "building-integrated" devices in commercial buildings, and can be placed at other point-of-use locations. All sectors of the photovoltaic market continue to grow. Global PV market growth has averaged 25%+ annually over the last 10 years, with worldwide growth rates for the last 5 years well over 35%. Significant state incentives are growing the domestic market. Successful candidates achieving the PV Entry Level Certificate of Knowledge will have the basic knowledge of solar electricity suitable for a supervised, entry level position with a dealer and/or installer or other PV industry company.

Description of the PV Entry Level Certificate of Knowledge

This Certificate will be a way for a student to demonstrate basic knowledge, comprehension and application of key terms and concepts of photovoltaic (solar electric) system operations. Schools and Training Programs will offer a course during a semester or other defined time period and then administer a NABCEP-issued exam. A candidate for the Certificate will have to complete this course and pass the test. While the Certificate of Knowledge by itself will not qualify an individual to install photovoltaic (PV) systems, it does recognize understanding of the basic terms and operational aspects of a PV system.

Learning Objectives

The PV Entry Level Certificate of Knowledge program is based on a set of learning objectives developed by a NABCEP Committee of PV subject matter experts. The Learning Objectives include ten (10) skill sets:

- PV Markets and Applications
- Safety Basics
- Electricity Basics
- Solar Energy Fundamentals
- PV Module Fundamentals
- System Components
- PV System Sizing
- PV System Electrical Design
- PV System Mechanical Design
- Performance Analysis and Troubleshooting

See the “Learning Objectives” document for the full description of these skills and tasks.

The skills identified in this analysis do not replace electrical trades, technician, technologist or engineering training.

NABCEP will periodically review the learning objectives and make any changes according to changes in the National Electrical Code or any technology changes. NABCEP will notify the provider of any modifications to the learning objectives.

Criteria for Provider Participation

The PV Entry Level Certificate of Knowledge program can be offered by any accredited university, college, community college, or vocational-technical institute; or offered by any Joint Apprenticeship & Training Committee or U.S. Department of Labor approved apprenticeship program; or offered by a training program accredited by the Institute for Sustainable Power or similar accrediting body.

Educational providers must complete the NABCEP “Provider Application.” The application is good for three years at which time, the provider must reapply with NABCEP.

Course(s) are required to have an interactive teacher-learner structure. This implies a connection between a learner and a learning source. It can include classroom time led by an instructor and/or discussion leader. It can also include activities in which a learner is engaged in a planned learning event in which he/she is separated from faculty and other students but where the learner receives some sort of feedback and the learner’s progress is monitored. Examples include computer-assisted instruction, interactive video/CD/DVD and/or web site learning.

Providers are required to provide students with the necessary information covering the NABCEP-issued learning objectives. This material shall be presented in a well developed way. Courses can include more than the learning objectives but must include a comprehensive review of them.

All providers must provide special testing accommodations and comply with the provisions of the Americans with Disabilities Act and with Title VII of the Civil Rights Act and other applicable laws.

All providers must provide a copy of the appropriate Certificate of Insurance(s) showing that professional liability and general liability policies are maintained with respect to the administration of examinations.

NABCEP has the right to make changes to these Criteria for Provider Participation and will notify the provider of any modifications.

Student Eligibility Rules

There is a two-step process for a student to achieve the Certificate. A candidate first has to successfully complete a course (or courses) offered by an educational provider who is registered with NABCEP. The candidate then has to pass the NABCEP-issued exam.

Candidates will have to fulfill the course requirements and meet any prerequisites determined by the provider. Unless otherwise directed by NABCEP, registered providers will apply their standard policies and procedures related to the provider's courses and exam administrations.

Teachers and instructors are not permitted to sit for the Entry Level Exam or open the sealed, individual exam booklets.

The Exam

The NABCEP-issued exam will align with the learning objectives by using an exam blueprint form. The exam will be based on psychometric practices and prepared by subject matter experts. A professional testing service will prepare the exam packages and send them in a secured way to the course provider. Exams will be administered and proctored on site at a location determined and announced by the provider. Exams will be returned to the professional testing service for scoring. Successful candidates will receive the PV Entry Level Certificate of Knowledge from the NABCEP office.

Providers will be required to sign an Agreement Form for Providers with NABCEP, agreeing to comply with applicable NABCEP policies, including those related to maintaining the security of the examination, confidentiality of the test items and other related issues.

All requests for examinations must be received by NABCEP **three weeks** prior to the actual exam administration date. Exam requests will be submitted to NABCEP by Providers along with the Student Application forms and students' checks/money orders. Providers may choose to enclose one check from the institution, representing the sum total of all student checks.

Course tuition will be set and collected by the course(s) provider. The exam/Certificate fee is set by NABCEP and will be transmitted with the student sign-up form by the provider directly to NABCEP.

Upon grading of the exams, NABCEP will send candidate scores directly to each candidate to the mailing address provided in the student sign-up form. A candidate passing the exam will receive the official NABCEP PV Entry Level Certificate of Knowledge. Providers will be sent a listing of the scores of each candidate. This listing will also contain the median score of all candidates taking the exam nationally.

Exam Time/Length: Candidates will be given up to two (2) hours to sit for the examination. The exam will consist of sixty (60) multiple choice questions.

Items Provided at the Exam: The exam is **NOT** an open book exam. The only material to be provided to candidates will be any formulas necessary to answer questions. These formulas will be provided in the Exam Booklet by NABCEP. Candidates should bring their own calculators to the exam.

NABCEP Exam/Certificate Fees: \$70.00 per exam.

Passing Score: The passing score for the exam is determined by NABCEP in consultation with our testing contractor in accordance with appropriate psychometric guidelines.

Exam Refunds: Permitted up to the time NABCEP places orders for the exams with the testing service.

Rescoring and Comment Policy: It is NABCEP'S policy for this exam not to permit any rescoring of exams. This is because exams are computer-scanned by the exam contractor multiple times to ensure accurate scoring. If candidates have a particular issue with a question, they will be provided with a comment form to list and explain such issues in writing.

Retaking the Exam: Students may take the exam one additional time at a scheduled, organized testing site without repeating the course. Students will be required to pay another exam fee. The student will need to make arrangements with a provider offering the course and may be required to pay an additional administrative fee set by the provider.

Use of the Certificate

Candidates who satisfy all NABCEP eligibility requirements may represent that they have been granted the PV Entry Level Certificate of Knowledge issued by the North American Board of Certified Energy Practitioners (NABCEP). All references to the credential must indicate the date the Certificate was issued, and may only be displayed in association with the credential holder. The Certificate is personal to the credential holder and may not be transferred, assigned to, displayed or used by any other individual, organization, business, or entity. Replacement Certificates are available from NABCEP for a small fee.

If you have any questions about NABCEP, please contact

North American Board of Certified Energy Practitioners

Saratoga Technology + Energy Park

10 Hermes Road, Suite 400, Malta, NY 12020

Phone: (518) 899-8186 Fax: (518) 899-1092

Email: kchristopher@nabcep.org

www.nabcep.org

NABCEP

Entry Level Certificate of Knowledge of PV Systems

A person with this certificate has basic knowledge of photovoltaic systems, suitable for a supervised, entry level position with a dealer/installer or other PV industry company. The skills identified in this analysis do not replace Electrical Trades, Technician, Technologist or Engineering training.

Learning Objectives to be tested

1. PV Markets and Applications	
Task/Skill	
1.1.	Describe history of PV technology and industry
1.2.	Describe markets and applications for PV (grid-tie, remote homes, telecom, etc.)
1.3.	Identify types of PV systems (direct motor, standalone with storage, grid-backup, etc.)
1.4.	Associate key features and benefits of PV with applications

2. Safety Basics	
Task/Skill	
2.1.	Identify safety hazards of operational and non-operational PV systems
2.2.	Identify safety hazards, practices and protective equipment during PV system installation and maintenance (electricity, batteries, roof work)

3. Electricity Basics	
Task/Skill	
3.1.	Explain difference between energy and power
3.2.	Define basic electrical terms
3.3.	Describe the use of digital multi-meter
3.4.	Calculate simple circuit values

4. Solar Energy Fundamentals	
Task/Skill	
4.1	Define basic solar terms (e.g., irradiation, Langley, azimuth)
4.2	Determine true (solar) south from magnetic (compass) south given a declination map
4.3	Describe Basic solar movement and effect of earth tilt
4.4	Predict solar position using solar path diagrams
4.5	Describe angular effects on the irradiance of array
4.6	Identify factors that reduce/enhance solar irradiation
4.7	Determine average solar irradiation on various surfaces
4.8	Convert solar irradiation into a variety of units
4.9	Determine effect of horizon on solar irradiation (shading)
4.10	Demonstrate use of Solar Pathfinder or sun charts

5. PV Module Fundamentals	
Task/Skill	
5.1.	Explain how a solar cell converts sunlight into electric power
5.2.	Label key points on a typical IV curve
5.3.	Identify key output values of solar modules using manufacturer literature
5.4.	Illustrate effect of environmental conditions on IV curve
5.5.	Illustrate effect of series/parallel connections on IV curve
5.6.	Define measurement conditions for solar cells and modules (STC, NOCT, PTC)
5.7.	Compute expected output values of solar module under variety of environmental conditions
5.8.	Compare the construction of solar cells of various manufacturing technologies
5.9.	Compare the performance and characteristics of various cell technologies
5.10.	Describe the components and construction of a typical flat plate solar module
5.11.	Calculate efficiency of solar module
5.12.	Explain purpose and operation of bypass diode
5.13.	Describe typical deterioration/failure modes of solar modules
5.14.	Describe the major qualification tests and standards for solar modules

6. System Components	
Task/Skill	
6.1.	Describe most common solar module mounting techniques (ground, roof, pole)
6.2.	Compare features and benefits of different solar mounting techniques
6.3.	Explain the relationship between solar module cell temperature and environmental conditions, given mounting method (e.g., NOCT)
6.4.	Describe purpose and operation of main electrical BOS components (inverter, charge controller, combiner, ground fault protection, battery, generator)
6.5.	Identify key specifications of main electrical BOS components (inverter, charge controller, combiner, battery, generator)

7. PV System Sizing	
Task/Skill	
7.1.	Illustrate interaction of typical loads with IV curve (battery, MPPT, dc motor)
7.2.	Analyze load demand for stand-alone and grid interactive service
7.3.	Identify typical system electrical output derating factors
7.4.	Calculate estimated peak power output (dc and ac)
7.5.	Calculate array and inverter size for grid-connected system
7.6.	Calculate estimated monthly and annual energy output of grid-connected system
7.7.	Explain relationship between array and battery size for stand-alone systems
7.8.	Calculate array, battery and inverter size for stand-alone system

8. PV System Electrical Design	
Task/Skill	
8.1.	Determine series/parallel PV array arrangement based on module and inverter specifications
8.2.	Select BOS components appropriate for specific system requirements
8.3.	Determine voltage drop between major components

9. PV System Mechanical Design
Task/Skill
9.1. Describe the relationship between row spacing of tilted modules and sun angle
9.2. Describe the mechanical loads on a PV array (e.g., wind, snow, seismic)

10. Performance Analysis and Troubleshooting
Task/Skill
10.1. Describe typical system design errors
10.2. Describe typical system performance problems
10.3. Associate performance problems with typical causes
10.4. List equipment needed for typical system performance analysis
10.5. Compare actual system power output to expected
10.6. Identify typical locations for electrical/mechanical failure

PROVIDER APPLICATION

TO PARTICIPATE IN THE NORTH AMERICAN BOARD OF CERTIFIED ENERGY PRACTITIONERS PHOTOVOLTAIC (PV) ENTRY LEVEL CERTIFICATE OF KNOWLEDGE

NABCEP's PV Entry Level Certificate of Knowledge is a way for students to show that they have achieved basic knowledge, comprehension and application of key terms and concepts of photovoltaic (solar electric) system operations. The certificate demonstrates that the student has taken a course or courses and has passed an industry-designed, NABCEP-issued exam.

Criteria for Participation

- The provider must complete and sign this application.
- Students must take a course or courses from a Registered Provider to become a candidate for this Certificate and to sit for the exam.
- Course (s) must be offered by any accredited university, college, community college, or vocational-technical institute; or offered by any Joint Apprenticeship & Training Committee or U.S. Department of Labor approved apprenticeship program; or offered by a training program accredited by the Institute for Sustainable Power or similar accrediting body.
- Course(s) are required to have an interactive teacher-learner structure.
- Providers are required to provide students with the necessary information that covers in a comprehensive way the NABCEP-issued learning objectives.
- Providers must provide special testing accommodations and comply with the provisions of the Americans with Disabilities Act and with Title VII of the Civil Rights Act and other applicable laws.
- All providers must provide a copy of the appropriate Certificate of Insurance(s) showing that professional liability and general liability policies are maintained with respect to the administration of examinations.

For more details about the Certificate program, please read the "Overview, Process & Policies" document.

PROVIDER APPLICATION

This application is good for a period of three (3) years.

(Please use additional pages if necessary and/or attach supporting documentation)

DATE: _____

NAME OF COLLEGE, SCHOOL, OR ORGANIZATION: _____

MAILING ADDRESS: _____

PHONE NUMBER: _____

WEB ADDRESS: _____

DEPARTMENT: _____

INSTRUCTOR'S NAME: _____

INSTRUCTOR'S E-MAIL ADDRESS: _____

DOES YOUR INSTITUTION OR PROGRAM HOLD ANY ACCREDITATIONS OR ARE YOU AFFILIATED WITH A JOINT APPRENTICESHIP & TRAINING COMMITTEE OR A U.S. DEPARTMENT OF LABOR APPROVED APPRENTICESHIP PROGRAM? PLEASE DESCRIBE: _____

COURSE (S) OR WORKSHOP TITLE: _____

PLEASE DESCRIBE THE COURSE (S) YOU WILL BE OFFERING.

PLEASE DESCRIBE THE COURSE STRUCTURE (traditional classroom, distance learning, etc.)

WHEN IS THE COURSE OFFERED? _____

ESTIMATED NUMBER OF ATTENDEES/STUDENTS: _____

HAVE YOU OFFERED THIS COURSE (S) IN THE PAST? IF SO, PLEASE DESCRIBE FOR HOW LONG AND ENROLLMENT SIZE.

***PLEASE ATTACH A COPY OF THE APPROPRIATE CERTIFICATE OF INSURANCE (S)**

This will usually take the form of a copy of your Commercial/General Liability coverage. In the case of some State institutions belonging to a self-insurance fund, a statement to that effect from a duly-recognized representative on official letterhead may be substituted.

If insurance documentation will be sent separately, please be advised your application will be held for processing until it is complete; please indicate on the lines below if you are having insurance documentation sent separately:

As an authorized representative of the identified organization, I represent and agree to the following: All of the information provided in this application is true and correct to the best of my knowledge. Approval of the Provider to participate in this PV Entry Level Certificate of Knowledge program cannot be transferred to another organization without prior approval from NABCEP. The organization will conduct all activities related to the NABCEP PV Entry Level Certificate of Knowledge program consistent with applicable laws, including the Americans with Disabilities Act and Title VII of the Civil Rights Act. The organization will satisfy the requirements of all applicable NABCEP policies, and maintain the security of the examination and confidentiality of the test items. NABCEP's logo or certification mark cannot be used on any course or promotional material or advertisement unless approved by NABCEP. Upon review of this application, NABCEP can request additional material. NABCEP's approval of this application can be revoked if the Provider is non-compliant with any of the policies established by NABCEP.

SIGNATURE _____

PLEASE PRINT NAME _____

DATE _____

APPROVED BY NABCEP: _____

DATE: _____

Please return your completed application to:
Karen Christopher, Operations Manager
North American Board of Certified Energy Practitioners
Saratoga Technology + Energy Park
10 Hermes Road
Malta, NY 12020
Phone: (518) 899-8186 Fax: (518) 899-1092
Email: kchristopher@nabcep.org



AGREEMENT FORM FOR PROVIDERS

NABCEP PV ENTRY LEVEL CERTIFICATE OF KNOWLEDGE

In consideration of NABCEP's decision to designate the undersigned organization as a Registered Provider of the NABCEP PV Entry Level Certificate of Knowledge, the Provider agrees to keep confidential and secure all NABCEP test information and materials, including, but not limited to: test items; examination forms; and all other test or examination-related materials. The Provider further agrees to use the same care and discretion to avoid disclosure, publication, or dissemination of NABCEP information and materials as the Provider uses with its own similar information that it does not wish to disclose, publish or disseminate. The Provider will report to NABCEP any potential or real breaches of security caused by, or known to, the Provider, or any of its representatives or agents as soon as such breaches are known or should have been known.

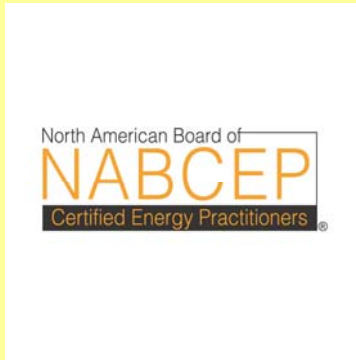
Provider Signature _____

Print Name _____

Date _____

Please return the form to:

Karen Christopher, Operations Manager
North American Board of Certified Energy Practitioners
Saratoga Technology + Energy Park
10 Hermes Road Malta, NY 12020
Phone: (518) 899-8186 Fax: (518) 899-1092
Email : kchristopher@nabcep.org



STUDENT SIGN UP FORM

TO TAKE THE EXAM

For the

NABCEP PV ENTRY LEVEL CERTIFICATE OF KNOWLEDGE

Please Print

STUDENT NAME: _____

STUDENT PERMANENT MAILING ADDRESS: (Enter address where exam results can be sent.)

E-MAIL ADDRESS: (Optional. To receive NABCEP news, program information and other information.)

NAME OF COLLEGE OR SCHOOL: _____

NAME OF INSTRUCTOR: _____

SCHEDULED DATE OF EXAM: _____

I have given my check or money order for \$70.00 (US) payable to NABCEP, to the instructor listed above.

By signing below, I authorize NABCEP to release the score I receive on the NABCEP PV Entry Level Certificate of Knowledge exam to my instructor. I understand that if I successfully pass the exam I will clearly and only represent that I have received or been granted the PV Entry Level Certificate of Knowledge issued by the North American Board of Certified Energy Practitioners (NABCEP), and I will include the date the Certificate was issued. I also understand that the Certificate is personal to me and may not be transferred, assigned to, displayed or used by any other individual, organization, business, or entity.

Student Signature: _____

Student Name (Please Print): _____

Date: _____

Please give this sign-up form, along with your check or money order, to your instructor. Your instructor will send this form and your exam fee to NABCEP.

If you have any questions about NABCEP, please contact

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