Virginia Solar Pathways Project: Solar Workforce Development Strategy

September 2017

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Introduction

As part of our Solar Pathways work, Dominion Energy committed to develop a solar workforce development strategy. To that end, Dominion Energy and partners:

- Evaluated solar jobs data in the United States and Virginia to look for trends;
- Gathered real-world data from actual solar installers operating in Virginia to supplement the workforce trend data;
- Derived "solar employment factors" to reflect the actual number of jobs created per increment of solar capacity;
- Worked with the Northern Virginia Community College (NVCC) to analyze job postings referencing "solar" and develop snapshot of solar-related Jobs in Virginia;
- Evaluated Dominion Energy's support for existing workforce development and education initiatives;
- Evaluated energy education courses and certificates currently available in Virginia; and
- Made recommendations for additional energy education pathways in Virginia.

Based on this analysis we found that:

- **The majority of solar jobs arise from the solar installation job sector, and most installation jobs are temporary in nature.** Solar jobs fall into four main categories, as represented by the Career Map developed by the Interstate Renewable Energy Council (IREC) shown below in **Figure 1**.[1] Those categories are manufacturing, system design, project development, and installation and operations. As reported by the Solar Foundation, the majority of solar jobs are created in the installations and operations sector. In terms of real-word experience, Dominion Energy's solar development activities have borne out this conclusion reflecting that majority of incremental job growth has resulted from the actual construction of new solar facilities. However, these jobs are temporary in nature, lasting five to six months, and once construction of a solar facility has been completed, minimal operations and maintenance work is required to maintain the facility.

- **Operational solar installations provide very few incremental jobs. -** In the utility sector, based on primary research conducted by Dominion Energy's Solar Pathways team, for every 20 MW utility-scale solar facility completed, only one incremental full-time equivalent (FTE) position is needed to carry out O&M functions.

- **The biggest concern voiced by solar installers to whom we spoke was the overall shortage of skilled tradespeople.** The Solar Foundation's data substantiates what we heard from the solar installation companies we interviewed. In a report issued in April, the Solar Foundation indicates that despite increased efforts by both public and private solar training organizations, solar installation companies around the entire country continue to complain of substantial difficulty finding qualified workers. Specifically, the report states that in 2016, 84% of solar installers in the U.S. reported challenges with filling open solar installation positions. Furthermore, over three-quarters (77.6%) of all employers report struggles finding candidates with any training specific to the position, and a similar number (77.9%) say they cannot find candidates with any relevant work experience. More specifically, the report states "Electrical

[1] http://irecsolarcareermap.org/ accessed August 27, 2017.

experience, soft skills (work ethic, dependability, critical thinking), and roofing experience ranked highest in terms of areas of expertise that are most difficult to find in solar job applicants." It goes on to note that 61% of employers cited experience in a non-solar construction trade important to hiring decisions.[2]

- **The Commonwealth should focus on emphasizing the skilled trades in general, rather than developing solar specific curriculum for entry-level workers. However, solar specific course work may be beneficial for employees seeking to advance in their careers beyond the entry-level roles.** The report suggested that training providers should work closely with employers to enhance solar training both pre and post-hire. Pre-hire training should concentrate on a preliminary understanding of system components and electric basics, safety, soft-skills, and should maximize opportunities for hands-on worksite experience. The solar installation companies with whom we spoke echoed these recommendations. Rather than solar specific training, they expressed a need for workers trained in the skilled trades, basic electricity, and soft-skills. In most instances, the installation companies provide on-the-job training specific to solar installation so there is not a critical need for workers to have specific solar installation training or certification prior to being hired.

- **A 17th Career Cluster focused specifically on the energy industry should be developed.** Currently, federal law mandates that states offer career and technical programs to equip students to successfully progress into postsecondary education or the workplace. Programs offered by each state may fall into one or more of 16 career clusters recognized by the Office of Vocational Adult Education (OVAE) and the National Association for State Directors of Career Technical Education Consortium (NASDCTEC). These clusters consist of occupational categories with industry-verified knowledge, skills, and abilities that describe the aptitudes necessary to achieve success in a given field. Unfortunately, energy jobs and the education pathways leading to these careers tend to get hidden in other education clusters, such as Architecture & Construction, Manufacturing, and Science, Engineering, Technology and Mathematics (STEM) because no specific Energy Career Cluster exists. With the importance of the Commonwealth of Virginia's clean energy future, it's time to have a cluster that focuses on the jobs needed for impending retirements.

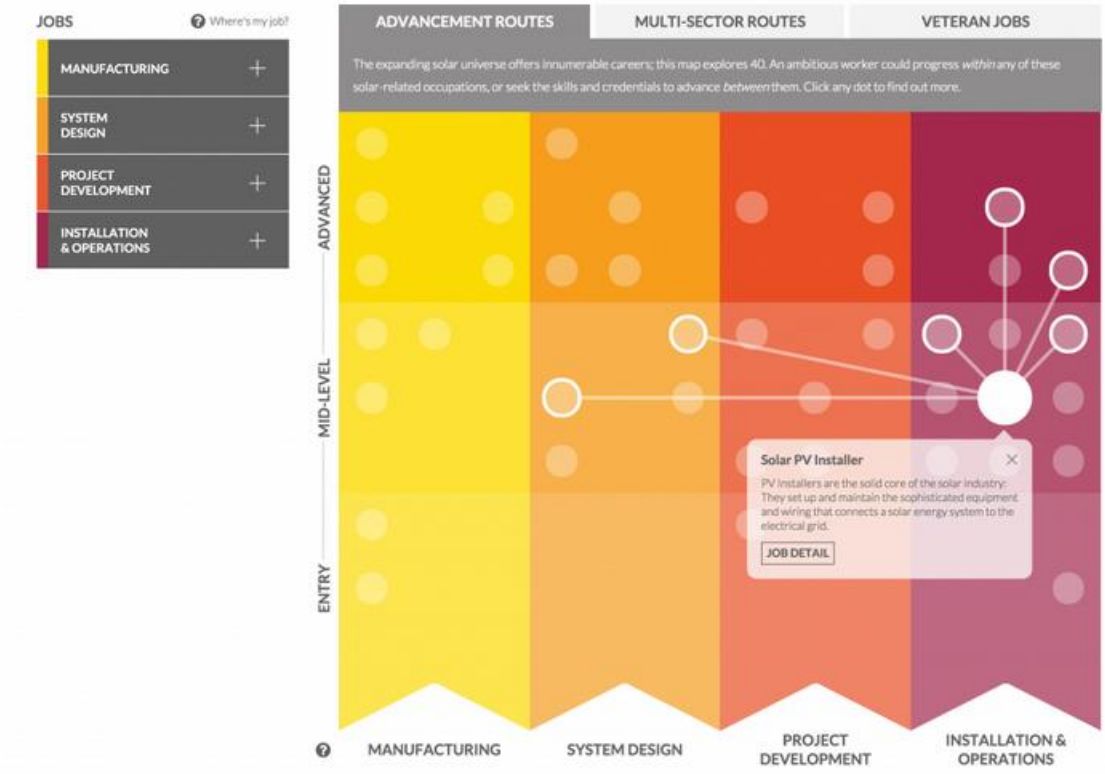
- **The Virginia Solar Pathways team also recommends that Virginia's Community Colleges partner with the industry to implement AAS degrees in Energy Technology.** These degrees may be general energy technology degrees with course options in power systems, nuclear, natural gas, and renewables to include solar. The AAS degrees may also have a specific focus such as Renewable Energy Technology or Solar Energy Technology; however, it is critical that the AAS degree foundational curriculum provide a broad-base of energy industry fundamentals in order to maximize employment opportunities for students attaining these degrees.

- **Any certificate or curriculum programs to support job-seekers in the solar installation sector should include two essential components: (1) Occupational Safety and Health Administration (OSHA) training and (2) preparation for the NABCEP Associate Exam.** All energy education programs should include an appropriate level of OSHA safety training. OSHA recommends Outreach Training Programs as an orientation to occupational safety and health for worker.

[2] The Solar Foundation, *2017 Solar Training and Hiring Insights: A Solar Training Network Research Report*, April 2017, pp. 1, 2, and 8.

North American Board of Certified Energy Practitioners (NABCEP, **http://www.nabcep.org/)** is one of the top preferred certifications for renewable and solar professionals. Ensuring that training programs include OSHA and NABCEP training and preparation for certification benefits both job-seekers and employers alike and should be incorporated into both certificate and curriculum programs.

Figure 1: IREC Solar Career Map – Overview



I. Solar Jobs Data – The U.S. and Virginia

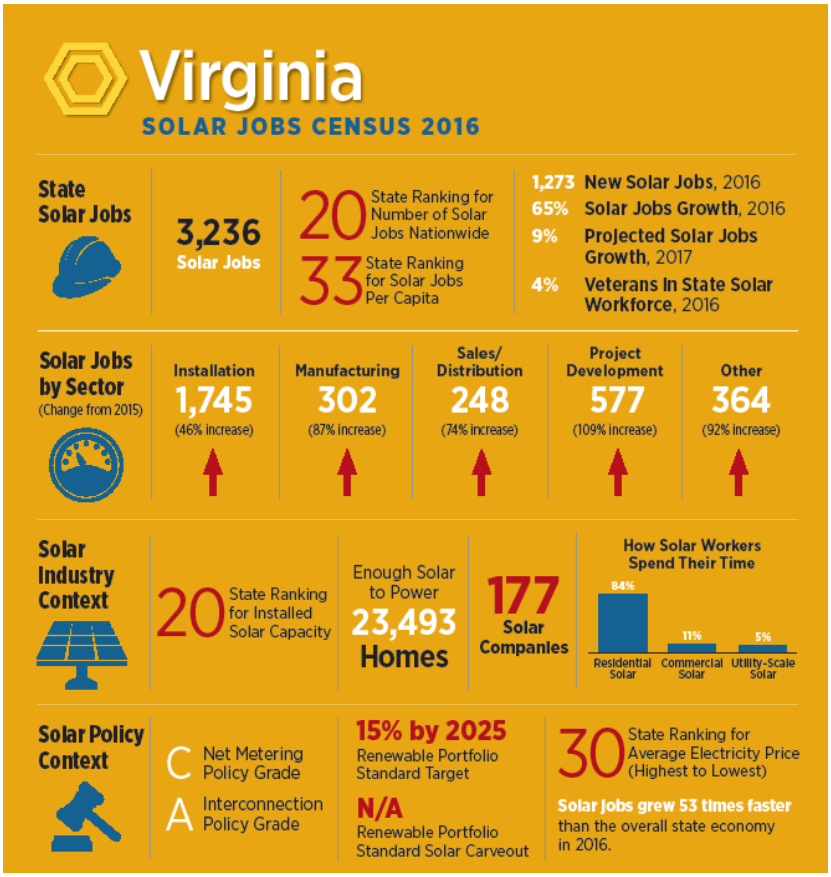
A. Solar Foundation Data

A review of the *2016 Solar Jobs Census*, published by the Solar Foundation in January of 2017, paints a quite favorable picture of solar industry job creation nationwide. The report indicates that the solar industry continues to create jobs at a faster rate than most other sectors of the economy, adding workers as a rate almost 17 times faster than the overall economy and accounting for 2% of all jobs created in the U.S. over the past year. The Solar Foundation's long-term research reflects that solar industry employment has increased by 178% since 2010, producing more than 166,575 new domestic living-wage jobs. The *2016 Solar Jobs Census* further reports that, as of November 2016, the solar industry employs 260,077 solar workers with the majority of those workers employed in the installation

sector. The installation sector represents 137,133 solar jobs (53% of all solar jobs) and 34% of new solar jobs for 2016, according to the Solar Foundation report.[3]

With regard to Virginia specifically, the Solar Foundation data shows a total of 3,236 solar jobs in the Commonwealth in 2016 which reflects a growth in solar jobs of 65% since 2015. See **Figure 2**. Virginia ranks 20th in the U.S. for solar jobs and 33rd for solar jobs per capita. Reflecting the nationwide trend, jobs in the solar installation segment make up the predominant number of solar jobs in the Commonwealth. As discussed, the incremental jobs produced from Dominion Energy's solar development activities have primarily occurred in the installation and operations sector. Therefore, in crafting its solar workforce assessment and recommendations, Dominion Energy and its Solar Pathways team chose to focus primarily on the Installation and Operations sector. We also felt it was important to gather real-world data from solar installers operating in Virginia to supplement the solar workforce data reported by the Solar Foundation and other industry groups.

Figure 2: Spotlight on Virginia[4]



[3] The Solar Foundation, *2016 National Solar Jobs Census*, January 2017.

[4] Excerpted from the Solar Foundation's, *Virginia Solar Jobs Census 2016, https://www.thesolarfoundation.org/solar-jobs-census/factsheet-2016-va/, accessed Sept. 13, 2017.*

B. Primary Data Gathered by the Virginia Solar Pathways Team

The Virginia Solar Pathways team believed it was important to gather real-world data from actual solar installers operating in Virginia to supplement the workforce trend data reported by the Solar Foundation, IREC and others. Accordingly, the team contacted several companies engaged in the solar installations and operations business in Virginia and requested that they complete a survey to provide information covering the following topics:

- Percentage of business that is solar related
- Number of employees, including temporary workers engaged in actual installation work
- Typical workflow for a solar construction project
- Workforce for a typical project size ("Solar Employment Factor")
- Certifications, Licensure, and Training required

i. Solar Employment Factor - Number of Incremental Jobs Created by Solar Installation

Dominion Energy derived "solar employment factors" to reflect the actual number of jobs created per increment of solar capacity. See **Table 1**. Since solar installation falls into three main size and type categories: utility-scale, commercial, and residential, we derived a factor for each except for the residential sector where available data was insufficient.

- **Utility-Scale – Solar Employment Factor**

Dominion Energy analyzed jobs data from seven utility-scale projects of approximately 20 MW each in size it has developed on the East Coast. It found that the average number of actual construction workers hired for this work was **145 temporary workers per 20 MW project**, **with these jobs lasting approximately 5 months**, which is the typical construction time for a 20 MW installation to be completed. Once completed, solar installations require minimal ongoing operational maintenance. Data gathered by Dominion Energy related to employment for operations and maintenance at solar installations once construction has been completed reflects that **approximately one full-time equivalent (FTE) operations and maintenance job is created for every 20 MW solar installation.**

- **Commercial-Scale – Solar Employment Factor**

A representative of Dominion's Solar Pathways Core Advisory team interviewed three solar installation companies engaged in doing installations in the commercial-scale category. These companies reported that they employed **between five to 10 temporary workers working 30 to 40 hours per week for a period of two to six months to complete solar installations ranging in size from 0.5 MW to 2 MW in size.** In terms of operations and maintenance, these three companies reported that **they employed between 0.1 and 1 FTE for O&M functions for every installation completed.**

- **Residential-Scale – Solar Employment Factor**

The Dominion Energy Solar Pathways Team contacted approximately 20 solar installation companies serving the residential community; however, we only received responses from two of these companies. The two companies responding indicated that they employ **approximately three temporary employees working approximately 20 hours per week for one month to complete a 10 kW solar installation.** No data was reported regarding employment for operations and maintenance.

Table 1: Solar Employment Factors

Category	No. of Incremental Temporary Jobs per Installation	Hours per Week	Project Duration	Incremental FTE O&M Jobs
Utility-Scale	145 temp jobs per 20 MW Project	~40 (subject to verification)	~5 months	~1
Commercial	5 to 10 temp jobs per 0.5 MW to 2 MW project	~30 to 40	~2 to 6 months	Between 0.1 and 1
Residential	3 temp jobs per 10 kW project	~20	~1 month	No data provided

ii. Summary of Survey Responses – Qualitative Information from Solar Installation Companies in Virginia

In total, the Solar Pathways team received survey responses from six solar installation companies. Three companies were engaged in solar installation for commercial scale projects (project sizes ranging from 0.5 MW to 2 MW), one company handles utility-scale projects (projects ≥ 20 MW) and two companies serve the residential customer segment.

For both residential installers, 100% of their business involves solar installation. Conversely, among the commercial installers, solar installation is only a fraction of their business for two of the companies surveyed, whereas the third commercial installer's business is 100% solar. For the company doing utility scale projects, solar installation is only a small fraction of their business.

At the companies where solar is not 100% of their business, management feels that the solar business is unpredictable and they are comfortable keeping solar as only a fraction of their more diversified portfolio. This may be a preferred model to hedge against the uncertainty of the solar market.

The commercial/industrial/utility scale installers have in-house engineers to do project design. Depending on the size of the project, during installation, the companies have anywhere from 4-20 full time employees. These employees are primarily supervisors (foreman) and licensed electricians or mechanics (millworks). These supervisors do not have any particular solar-related certifications and are primarily OSHA-30 trained. Some companies were unfamiliar with NABCEP certification. A few mentioned that added certification would be advantageous for career advancement.

The medium and large scale installers rely on temporary labor to do the installation under the supervision of the full-times employees. The medium-sized companies look for temporary workforce with some construction/trade experience, particularly roofing experience. The large scale installers typically recruit on-site and provide basic installation (racking) training on site. A key takeaway from our conversations with installers is that the industry is not looking for any particular solar-specific training for entry-level employees, rather they view work-ethic, construction experience, and having some sort of mechanical inclination as important, given that the physical installation of solar panels is a relatively low-tech, labor intensive process.

Our conversations with installers left us to conclude that there is only a small subset of primarily white-collar jobs that would require specific training/knowledge in solar. These would include engineering, marketing, and financing. These functions fall in the manufacturing, system design, and project development solar job segments, as opposed to installations and operations.

iii. Occupational Data Gathered by Northern Virginia Community College

NVCC, a core advisor to the Virginia Solar Pathways Project team, gathered solar labor market data for the three main regions of the Commonwealth where Dominion Energy operates: Hampton Roads (Eastern), Northern Virginia (Northern), and the Richmond Metropolitan Area (Central).

Region Specific Job Posting Data in Virginia

The NOVA Workforce team, which is the Workforce Development Division at NVCC, analyzed job postings referencing "solar" for the last 12 months in the northern, eastern, and central Virginia regions. The full data set is attached as ***Appendix A***. The source for the data is Burning Glass, 2017. This was a rather simple query searching the keyword: solar in the different regions of the Commonwealth. However, a more sophisticated query with more detailed parameters could be done to provide more targeted information.

Region Specific Occupation Snapshot of Solar-Related Jobs in Virginia

The NOVA Workforce team at NVCC also compiled data on occupations that could be solar-related. Most jobs in the list were not solar specific; rather the list contains a broad range of professions that could be utilized in the solar industry, e.g. computer network architects, lawyers, marketing managers, etc. The list did contain certain jobs that were directly applicable to the solar industry, such as "Solar Photovoltaic Installers". The full dataset is attached in three appendices: ***Appendix B*** **– Eastern VA;** ***Appendix C*** **– Northern VA;** and ***Appendix D*** **– Central VA (Richmond)**. The source for this data was JobsEQ by Chmura Economics, 2017.

Table 3: Occupation Snapshot – "Solar Photovoltaic Installers"[5]

	Four quarters ending Q1 2017			10 Year Forecast
VA Region	No. of Workers Employed	Avg Annual Wages	Unemployment Rate	Avg Annual Growth Percentage
Northern	81	$43,000	8.10%	2.70%
Eastern	55	$35,800	9.60%	1.60%
Central	50	$37,300	8.70%	2.20%

II. Dominion Energy's Support for Existing Workforce Development and Education Initiatives

Dominion Energy has long been committed to workforce development and educational partnerships with an interest in educating and developing future workforce talent pipelines. Some examples of these efforts include our involvement with the Center for Energy Workforce Development (CEWD), support of educational programs through our foundation, and more.

Center for Energy Workforce Development (CEWD)
http://www.cewd.org/

Dominion Energy has been a member of CEWD since 2007. CEWD is a national non-profit 501(c)(3) organization of electric, natural gas, and nuclear utilities formed in 2006 to help utilities work together to develop solutions to the coming workforce shortage in the utility industry. Their associations include the Edison Electric Institute (EEI), American Gas Association (AGA), Nuclear Energy Institute (NEI), American Public Power Association (APPA), National Rural Electric Cooperatives Association (NRECA), and the unions who serve these industries - International Brotherhood of Electrical Workers (IBEW) and Utility Workers Union of American, AFL-CIO (UWUA). In addition to energy and utility companies around the country, members also include education partners - technical high schools, community and technical colleges, and four year colleges and universities.

Virginia Energy Workforce Consortium (VEWC)
http://consortia.getintoenergy.com/virginia/

As an active member of CEWD, Dominion Energy has also been a leader in CEWD's Virginia state level workforce consortium, the Virginia Energy Workforce Consortium (VEWC). Through the VEWC, Dominion Energy and the other members have been able to implement and accomplish the following:

Career Awareness

- Offered a Women in Sustainable Energy (WISE) career exploration workshop, leadership development training, a suite of ongoing supportive services tailored to meet women's specific needs, and assessments that direct participants to further portable, stackable credentials and training in targeted fields. (2012)

[5] NOVA Workforce (the Workforce Development Division of Northern Virginia Community College) and JobsEQ by Chmura Economics, 2017.

- Conducted an Energy and Power Workshop and tours at the Virginia Technology and Engineering Educators Association Annual Conference in July 2016 to promote the Energy and Power Certificate course for high schools.
- Work with the Office of the Governor of Virginia to recognize and proclaim "Careers in Energy Week" each October.

Education

- 9 week Energy & Utility Job Training program implemented in partnership with Goodwill of Greater Washington DC and Alexandria Public Schools – Adult Education. (2017)
- Central Virginia and John Tyler Community Colleges implemented an Energy Technology Career Studies Certificate. (2016)
    - Central Virginia Community College's certificate includes a course on Photovoltaic Energy Systems.
- Virginia Department of Education Career and Technical Education approved an "Energy and Power" course for Virginia high schools. (2014)
- Power Line Worker Training program launched at Southside Virginia Community College. (2016)

Military & Veteran

- Tidewater Community College offers the Solar Ready Vets program developed by the Department of Energy to connect skilled veterans to the solar energy industry, preparing them for careers as solar photovoltaic system installers, sales representatives, system inspectors, and other solar-related occupations. This program began in 2015 and is enabled by the U.S. Department of Defense's SkillBridge initiative.
- Partnered with the Virginia Community College System (VCCS) and three community colleges to identify a consistent process for awarding credit for prior military training and experience in 2013. Hosted the VCCS Military and Veteran Summit in March 2017 where the VCCS presented processes and resources to its colleges. (2013, ongoing)
- Hosted a Virginia Values Veterans (V3) Employer Training Day in October 2016 for energy and utility companies.
- Spearheaded the pilot and launch of the Troops to Energy Jobs program from 2011 through 2013. Continue to participate in and leverage the program and resources.

Workforce Development

- Convened a Regional Energy Education Pathway meeting in Harrisonburg, VA with five area high schools, two community colleges and James Madison University's Center for Wind and Renewable Energy to discuss the region's demand for energy education pathways. (2017, ongoing)
- Co-hosted the "Energy Workforce and Educational Pathways" meeting for more than 100 Virginia educators, industry and workforce organizations at the Library of Virginia to address Virginia's Energy workforce demand, workforce development best practices and the demand for Energy specific educational pathways. (2017)
- Committed to partnerships with Virginia Nuclear Energy Consortium, Central Virginia Energy Alliance, and other Energy associations and councils in Virginia. (2015, ongoing)
- Coordinated with the Governor's Office monitoring current Energy Plan and communicating VEWC's progress and support since 2012.
- Facilitated and participated in energy workforce development workshops at the Annual Governor's Conferences on Energy since 2012.

Dominion Energy Charitable Foundation

The Dominion Energy Charitable Foundation is Dominion Energy's philanthropic arm dedicated to improving the physical, social and economic well-being of the communities served by its companies. The Foundation operates separately from Dominion Energy's companies. Its governing principles prevent Dominion Energy, Inc. or any of its companies from receiving a benefit or advantage in return for contributions, donations, or grants made by the Foundation. The Dominion Energy Charitable Foundation supports educational programs at the K-12, community college, and 4 year university and college levels. Since 2015, the Foundation has given more than $3 million to Virginia high schools and colleges.

Programs the Foundation has supported include:

- Dominion Energy Solar for Students program and the National Energy Education Development Project
- Virginia Community College System's Solar Energy Career Pathways
- Solar Energy STEM Camps and Classes for the Fauquier Excellence In Education Foundation
- Project PROGRESS (Promoting Renewable energy research On the Grid to create Responsible STEM workforce in Solar Sustainability across the Commonwealth) for the George Mason University Foundation

Solar for Students Program
https://www.dominionenergy.com/community/charitable-giving/solar-for-students-program

Beginning in 2016, the company has offered the Solar for Students Program to qualifying schools and organizations in Virginia. To date, there are 10 participating schools and organizations, **18** desktop computers powered by each solar array, and 15 42-inch LED TVs powered by each solar array. The program provides students the chance to observe and learn firsthand about harnessing solar energy from a solar array. The NEED Project (National Energy Education Development) and Sigora Solar, a Virginia-based solar installer, administer the program by providing technical support, coordinating the installation of solar panels, preparing educational materials for students and training the teachers.

Virginia Community College System's Solar Energy Career Pathways

The company has also supported the Virginia Community College System's effort to increase the number of certificates and certifications in energy technologies, specifically solar energy, offered at its constituent educational institutions. The Solar Energy Career Pathways program brought together college faculty and industry experts with the goal of developing a standardized, statewide curriculum that aligns with industry skill and competency needs. The colleges selected for inclusion in the program already had a certificate or associates-level energy or electrical program, or were otherwise located in a region with a shortage of energy workers.

Solar Energy STEM Camps and Classes for the Fauquier Excellence in Education Foundation
http://www.fauquiereie.org/programs/new-projects

In 2015, the company gave funds to support the creation of hands-on interactive learning opportunities through summer camps and in-class curricula in Fauquier County. Through a partnership with Fauquier County Public Schools, and by requesting a grant from the Dominion Energy Charitable Foundation, the Fauquier Excellence in Education Foundation was able to expand summer camp and class offerings to include options focused on STEM topics, including solar energy.

Elementary and middle school students were able to participate in lessons pertaining to how solar collectors create energy and how tracking the sun's position can help determine their optimal placement. In camp and in the classroom, participants also had the chance to create solar generators for charging batteries and solar-powered vehicles.

Project PROGRESS (Promoting Renewable energy research On the Grid to create Responsible STEM workforce in Solar Sustainability across the Commonwealth)
http://journals.gmu.edu/ITLCP/article/view/1560

The company partnered with the George Mason University Foundation to launch Project PROGRESS in 2016. The pilot initiative was designed to create a unique multidisciplinary opportunity for participating undergraduate students and faculty to grow and sustain interest in renewable energy research. A total of 20 students enhanced their STEM literacy in a new "STEM For Solar" course which saw them assemble 12-volt standalone solar power systems, so-called Solar Suitcases. Undergraduates then took on a mentorship role, using their suitcases to promote interest in solar energy at the middle and high school level. Those students were then invited to engage in self-directed research on solar energy as it relates to critical energy infrastructure, smart grid technology, and sustainability in Virginia.

As Dominion Energy and the Commonwealth of Virginia continue to expand our solar capacity, Dominion Energy is committed to supporting continued opportunities to align the workforce development efforts and educational pathways to specifically address the demands of solar in Virginia.

III. Energy Education Courses and Certificates currently available in Virginia

Based on the efforts of Dominion Energy, the members of the VEWC and others, the following education courses and certificates currently exist in Virginia.

- **Energy and Power Course** – Approved by the Virginia Department of Education in the first quarter of 2014 and using the framework of CEWD's Energy Industry Fundamentals certificate course, the Energy and Power course provides students a comprehensive look at the Energy industry exploring generation, transmission, and distribution of electricity and natural gas, including renewable sources of energy.
  - The following schools will offer this course in school year 2017 – 2018:
    - Bridging Communities Regional Career & Technical Center (New Kent, VA)
    - Brunswick High School (Lawrenceville, VA)
    - Chesterfield Career and Technical Center (Chesterfield, VA)
    - Cumberland High School (Cumberland, VA)
    - Dinwiddie County CTE (Dinwiddie, VA)

    - Rockbridge County High School (Lexington, VA)
    - Southern Virginia Higher Education Center (South Boston, VA)
  - Energy & Power Course Description - http://www.cteresource.org/verso/courses/8448/energy-and-power-description

- **Renewable Energy and Sustainable & Renewable Technologies Courses** – The Virginia Department of Education also offers renewable energy courses to Virginia high schools:
  - Example: Rockbridge County High School in Lexington, VA will begin offering a solar / renewable program in 2017 – 2018 which will include the Energy and Power, Renewable Energy, and Sustainable & Renewable Energy courses.
  - Renewable Energy Course Description – http://www.cteresource.org/verso/courses/8408/renewable-energy-description
  - Sustainable & Renewable Course Description - http://www.cteresource.org/verso/courses/8414/sustainability-and-renewable-technologies-description

- **The National Energy Education Development (NEED) Project – Solar Curriculum** – As part of Dominion Energy's Solar for Students program, the NEED Project (National Energy Education Development) and Sigora Solar, a Virginia-based solar installer, administer the program by providing technical support, coordinating the installation of solar panels, preparing educational materials for students and training the teachers.
  - Curriculum Resources - http://www.need.org/solar

- **Energy Technology Career Studies Certificate (CSC**) – Offered at the community college level, the Energy Technology CSC is a for credit, energy core curriculum certificate which includes the following courses: Energy Industry Fundamentals, basic electricity, basic hand tools, basic instrumentation, blueprint reading, college and applied math. Schools may add additional courses at their discretion.
  - The following Virginia Community Colleges offer this CSC:
    - Central Virginia Community College (CVCC) in Lynchburg, Virginia – CVCC's certificate includes a Photovoltaic Energy System (solar) course.
      - Curriculum Description - https://centralvirginia.edu/Programs-Classes/Industry-and-Manufacturing/Energy-Technology
    - John Tyler Community College in Chester, Virginia
      - Curriculum Description - https://jtcc.edu/majors/energy-technology-csc
    - Paul D Camp Community College in Franklin, VA – Includes a Photovoltaic Energy system (solar) course.
      - Curriculum Description - https://www.pdc.edu/wp-content/uploads/2012/01/Gedt_Energy_Technician.html

- **Renewable Energy Technologies CSC** – Tidewater Community College in Norfolk, Virginia offers this CSC which prepares someone for a career in renewable energy industry and addresses the design, installation and maintenance of alternative energy systems, including solar, thermal and wind. This CSC is very similar to the Energy Technology CSC, except that it includes the Solar Power Installations and Solar Power - Photovoltaic and Thermal courses and does NOT include the Energy Industry Fundamentals course.

  - Curriculum Description - https://www.tcc.edu/academics/mechanical-industrial/programs/renewable-energy-technologies-career-certificate

- **Solar Ready Vets –** Tidewater Community College has partnered with the U.S. Department of Energy and Navy Region Mid-Atlantic for a free program that prepares transitioning sailors for potential employment in the solar industry upon discharge. This program is enabled by the U.S. Department of Defense's SkillBridge initiative.
  - Course Description - https://tcc.augusoft.net/index.cfm?method=ClassInfo.ClassInformation&int_class_id=3787

- **Complete List of Energy Industry Certificates at the Virginia Community Colleges –** See ***Appendix E*** **– VCCS Energy and Solar Credential Course List.**

IV. Recommendations for Additional Energy Education Pathways in Virginia

According to the Center for Energy Workforce Development's (CEWD) annual workforce demand reports (http://www.cewd.org/Workforce/), nearly 2,000 of Virginia's current energy workers are expected to retire or leave the industry by 2024. Nearly one-third of Dominion Energy's workforce will be eligible to retire in that same timeframe. These demand reports focus on the industry's critical positions including engineers, technicians, plant/field operators, and line workers. While these workforce demand reports likely do not account for the recent growth and planned growth in the state's solar capacity since the last one was produced in 2016 representing 2015 data, future reports may better account for the solar workforce demand in Virginia.

In Virginia there is an opportunity to increase the types and numbers of energy education programs offered across the state. According to the Virginia Energy Workforce Consortium (VEWC) and other state workforce organizations, there is an immediate need to implement workforce and talent pipeline development and educational pathways to address these challenges.

Based on research and analysis by the Virginia Energy Workforce Consortium and Dominion Energy, the following energy education courses, certificates, degrees and pathways are recommended for the Commonwealth of Virginia.

Recommendation I: Skilled Trades – As noted in the introduction, the biggest challenge voiced both by solar installation companies we interviewed and those interviewed by the Solar Foundation is a dearth of job applicants trained in the skilled trades. As the Solar Foundation reports, employers indicate that they place greater value on technical ability, safety techniques, and soft skills common to all companies as opposed to training specific to solar installation.[6] Accordingly, the best thing that the Commonwealth could do to support both solar installation companies and entry-level job seekers would be to focus on expanding programs offering training and certification in the skilled trades. The Commonwealth should promote initiatives that bring together workforce development boards, employers, and educational institutions to develop a strategy and action plan to fill the gap in training that exists for skilled trade jobs, such as solar installation.

[6] Solar Foundation, *Solar Training and Hiring Insights*, April 2017, p.6.

Recommendation II: 17th Energy Career Cluster – Currently, federal law mandates that states offer career and technical programs to equip students to successfully progress into postsecondary education or the workplace. Programs offered by each state may fall into one or more of 16 career clusters recognized by the Office of Vocational Adult Education (OVAE) and the National Association for State Directors of Career Technical Education Consortium (NASDCTEC). These clusters consist of occupational categories with industry-verified knowledge, skills, and abilities that describe the aptitudes necessary to achieve success in a given field.

Unfortunately, energy jobs and the education pathways leading to these careers tend to get hidden in other education clusters, such as Architecture & Construction, Manufacturing, and Science, Engineering, Technology and Mathematics (STEM) because no specific Energy Career Cluster exists. With the importance of the Commonwealth of Virginia's clean energy future, it's time to have a cluster that focuses on the jobs needed for impending retirements. By integrating an Energy Career Cluster in the current system, we can increase awareness among secondary students of the knowledge and skill sets required for energy jobs, allowing those students adequate time to utilize the recommended program of study. In some states, students would be able to attend a career academy with a concentration in energy. A Cluster may be added at the state level and does not require federal approval. The Energy and Power course (Energy Industry Fundamentals) would be the cornerstone for this cluster in Virginia. It is critical that this cluster also include solar and renewable energy courses and pathway options. The CEWD Energy Career Cluster Toolkit can be found at this address:
http://www.cewd.org/toolkits/17thCareerCluster/17thCareerCluster-FullToolkit.pdf

Recommendation III: Associates of Applied Science (AAS) Energy Technology Degrees – Building on the career studies certificates offered in some of the community colleges in Virginia and the opportunities for colleges to work with their high schools to recognize energy and technical curriculum for dual enrollment credits, it is recommended that Virginia's Community Colleges partner with the industry to implement AAS degrees in Energy Technology. These degrees may be general Energy Technology degrees with course options in power systems, nuclear, natural gas, and renewables to include solar. The AAS degrees may also have a specific focus such as Renewable Energy Technology or Solar Energy Technology.

Bismarck State College (BSC) in North Dakota and Ecotech Institute in Colorado offer program models that should be assessed for potential replication in Virginia. BSC offers several energy program courses and degrees including an AAS in Electric Power Technology. Specific to renewable energy, Ecotech offers an AAS in Renewable Energy Technology in which the first two quarters of the program are available online. Further information on program offerings at these institutions, can be found below:

- Bismarck State College – Energy Programs

https://bismarckstate.edu/energy/programs/

- Ecotech Institute – Renewable Energy Technology Program

https://www.ecotechinstitute.com/degrees/renewable-energy-schools

Recommendation IV: North American Board of Certified Energy Practitioners Certification (NABCEP) and OSHA Training– Any certificate or curriculum programs to support job-seekers in the solar installation sector should include two essential components: (1) Occupational Safety and Health Administration (OSHA) training and (2) preparation for the NABCEP Associate Exam.

All Energy education programs should include an appropriate level of OSHA safety training. OSHA recommends Outreach Training Programs as an orientation to occupational safety and health for worker.

- Specific certifications may include:
  - OSHA 10 - The OSHA 10 Hour Construction Industry Outreach Training Program is intended to provide an entry level construction worker's general awareness on recognizing and preventing hazards on a construction site.
  - OSHA 30 - The OSHA 30-hour Construction Industry Outreach Training course is a comprehensive safety program designed for anyone involved in the construction industry. Specifically devised for safety directors, foremen, and field supervisors; the program provides complete information on OSHA compliance issues.

North American Board of Certified Energy Practitioners (NABCEP, **http://www.nabcep.org/)** is one of the top preferred certifications for renewable and solar professionals. They also offer NABCEP Company Accreditation for companies. Earning a NABCEP certification or company accreditation provides increased credibility, increased market value, and competitive advantages in the solar industry compared to those who do not possess similar certifications or accreditations.

- Specific certifications may include:
  - PV Installation Professional Certification - The target candidate for this NABCEP certification is a range of installation personnel including but not limited to: installers; project managers; installation, foreman/supervisor, and designers.
  - Solar Heating Installer Certification - The target candidate for NABCEP certification is the person responsible for the system installation (e.g., contractor, foreman, supervisor, or journeyman).
  - PV Technical Sales Certification - The target candidate for NABCEP certification is a person with job descriptions such as sales person, application engineer, financial or performance analyst, or site assessor.

V. Conclusions

The majority of solar jobs arise from the solar installation job sector. Solar installation jobs are temporary in nature, but the installation sector employs thousands of workers and these are jobs that cannot be outsourced to other countries. While under construction, a large solar facility will employ hundreds of workers. Once operational, solar facilities require very little maintenance, and as a result, produce very few incremental long-term O&M jobs. In the utility sector, based on primary research conducted by Dominion Energy's Solar Pathways team, for every 20 MW utility-scale solar facility completed, only one incremental full-time equivalent (FTE) position is needed to carry out O&M functions**.** However, most solar installations in Virginia are new, and there may be an increased need for maintenance jobs as the installations age.

One of the biggest challenges facing the installation companies is difficulty filling open installation positions. This difficulty was reported by the Solar Foundation as well as by solar installation companies interviewed by the Virginia Solar Pathways team. None of the solar installation companies interviewed by the Virginia Solar Pathways team require any solar specific training or certification as a pre-requisite for an entry-level installer job; however, they emphasized a significant challenge in finding entry-level employees that have general experience in construction or other skilled trades, basic electricity, and soft-skills.

Several high schools and certain community colleges in Virginia already offer energy-related courses. Some courses provide energy industry fundamentals. Other courses focus specifically on renewable energy technologies.

The Commonwealth should consider focusing on emphasizing the skilled trades in general, rather than developing solar specific curriculum for entry-level workers. However, solar specific course work may be beneficial for employees seeking to advance in their careers beyond the entry-level roles.
Given the dynamic nature of the energy industry and the diverse suite of technologies used to generate, transport, and deliver energy, including renewable and conventional technologies, students are best served by course-work and certifications that provide a broad-based knowledge of the industry, such as the Energy and Power Course approved by the Virginia Dept. of Education in 2014.

A 17th Career Cluster focused specifically on the energy industry should be developed. With the importance of the Commonwealth of Virginia's clean energy future, it's time to have a cluster that focuses on the jobs needed for impending retirements. By integrating an Energy Career Cluster in the current system, we can increase awareness among secondary students of the knowledge and skill sets required for energy jobs, allowing those students adequate time to utilize the recommended program of study. A Cluster may be added at the state level and does not require federal approval so this is something that could move forward now at the state level.

The Virginia Solar Pathways team also recommends that Virginia's Community Colleges partner with the industry to implement AAS degrees in Energy Technology. These degrees may be general energy technology degrees with course options in power systems, nuclear, natural gas, and renewables to include solar. The AAS degrees may also have a specific focus such as Renewable Energy Technology or Solar Energy Technology; however, it is critical that the AAS degree foundational curriculum provide a broad-base of energy industry fundamentals in order to maximize employment opportunities for students attaining these degrees.

Finally, any certificate or curriculum programs to support job-seekers in the solar installation sector should include two essential components: (1) Occupational Safety and Health Administration (OSHA) training and (2) preparation for the North American Board of Certified Energy Practitioners (NABCEP) Associate Exam. While certification in OSHA and NABCEP are not universal pre-requisites for entry-level positions, two of the most valuable aspects of any certificate or curriculum program to support students seeking jobs in solar installation are OSHA and NABCEP certifications.