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Clean Energy Education Study Results and Recommendations: Curriculum to Change Lives and Address Climate Change

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Abstract

Energy production is a critical requirement of everyday life, and the movement to decarbonize energy systems has led to the use of clean energy technologies. Learning about these alternative energy systems and the skills required to produce them is an important part of engineering technology training. Clean Energy (CE) Education is the evolution of traditional disciplines to educate candidates in the multidisciplinary field of clean energy. According to the University at Buffalo Regional Institute, growth in clean energy technologies and manufacturing in recent years has increased the demand for engineers and technicians trained in these areas [1].

This paper summarizes survey and interview findings, recommends a curriculum for teaching the skills essential to clean energy technicians, and emphasizes the transferability of skills to serve multiple disciplines. The participants were selected to understand the problem from the point of view of clean energy education stakeholders in New York state. The qualitative and quantitative findings were compared, combined, or provided as stand-alone conclusions through a mixed methods analysis of 72 respondents to an online survey and 13 interviews of industry, education, and community leaders.

In addition, the study provides educational action plans for creating CE training programs for clean energy companies, trainers, and academic institutions. Programs are necessary to teach candidates the skills to secure jobs that support the global energy transition away from fossil fuels. CE training programs benefit the industry by receiving well-trained technicians to close employment gaps, benefit academia through increased enrollment in clean energy-related industry training, and benefit students who enter the clean energy education program and gain living wage employment. Recommendations on recruiting candidates will simultaneously provide opportunities for underserved communities, benefitting individuals and their support networks. Conclusions describe what a robust CE education program, enrollment strategies, and community support would look like. The findings also address cultural resistance, as acceptance of climate action science is necessary for the success of CE initiatives, and those initiatives will also support science dialogue against political polarization. The proposed program supports increased social justice by centering workforce development challenges in low-income communities and identifying strategies to recruit underserved candidates into technical training, which provides a path to upward social mobility. Moreover, the proposed program promotes community collaboration since community, industry, and higher education leaders must communicate and agree on action plans to invest in clean energy technicians.

I. Introduction to Clean Energy Education Study Results

Energy production is a critical requirement of everyday life, and the movement to decarbonize energy systems has led to the use of clean energy technologies [2]. Learning about these alternative energy systems and the skills required to produce them is an important part of engineering technology training [3]. This research aimed to identify clean energy technology skills and professional skills required for employment in the field as assessed by surveying and interviewing opinions of clean energy education stakeholders. The conclusions identify best practices for creating effective clean energy education programs.

Clean energy industries are growing nationwide, and economic development officials in the region and state identify the clean energy sector as an area for targeted growth and investment [1]. New York State has bold targets for reducing greenhouse gas emissions through energy efficiency and adopting renewable energy, as the Climate Leadership and Community Protection Act (CLCPA) commits New York to incrementally achieving net-zero greenhouse gas emissions by 2050 [9]. The CLCPA accelerates the development of renewable energy, energy storage technology, and climate-related equity in disadvantaged communities, as the investment scoping plan requires that 40% of the benefit of investment should be delivered to underserved minority communities [9]. In addition, the New York State Climate Action Council (NYS CAC) projects support the creation of jobs in clean energy businesses that are in New York and in businesses that serve Disadvantaged Communities, with dedicated support for minority- and women-owned

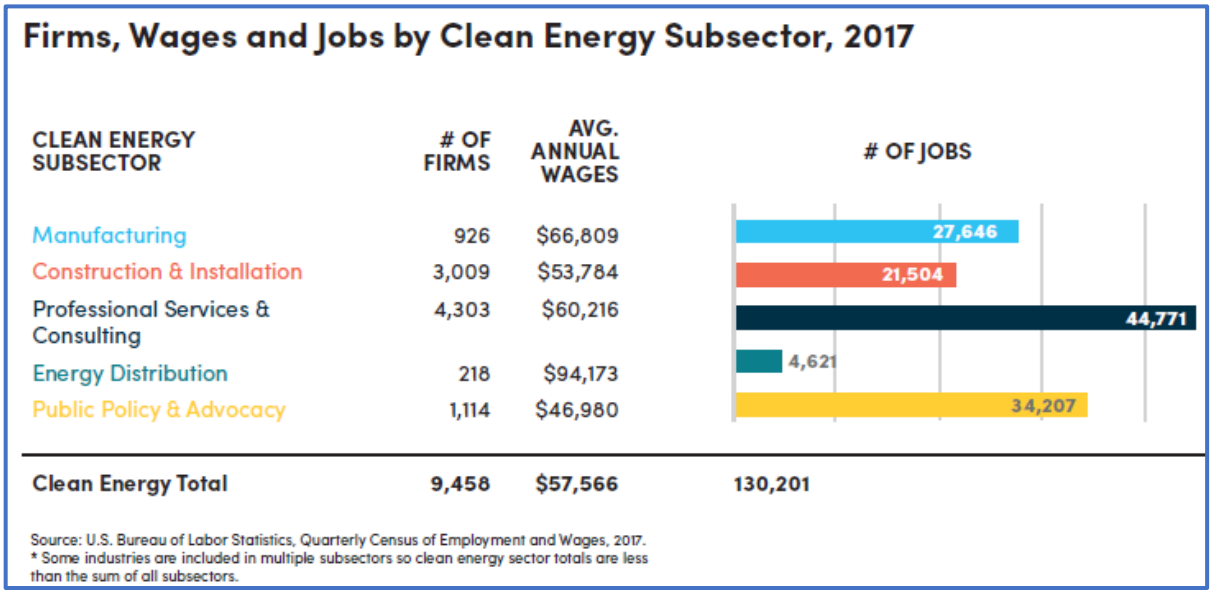

Figure 1. Western New York Clean Energy Workforce Assessment Report [1].

business enterprises to innovate and actively participate in the transformation [12]. Renewable energy job opportunities are illustrated in Figure 1 from the University at Buffalo Regional Institute clean energy workforce assessment report [1].

This study determined findings from answering the original research question:
As understood by clean energy education stakeholders in New York state:

1. What is the most efficient Clean Energy training/educational method to turn a student into an employment-ready clean energy engineering technician?
2. How can career pathways for new entrants into Clean Energy be made accessible to disadvantaged communities?

The qualitative and quantitative findings were compared, combined, or provided as stand-alone conclusions through a mixed methods analysis of 72 respondents to an online survey and 13 interviews of industry leaders, education, and community leaders. Additionally, this research considered the social justice aspect of building a CE training program to engage with marginalized communities, providing equal access to educational resources, and making intentional connections to community groups to recruit underrepresented students to join an academic pathway to CE employment [4]. Program graduates can contribute to educational, social, and economic change in their communities in the Buffalo Niagara Metropolitan area [5].

The structure of this paper provides an understanding of the author's positionality, research narrative, motivation, mixed methods research design, conceptual framework, survey and interview demographics, and results. The paper concludes with themed results from surveys and interviews and a summary and conclusions.

A. Clean Energy Education: So, what? Why now?

Clean Energy Education is the evolution of traditional disciplines to educate candidates to meet the demand for engineers and technicians to support the global energy transition away from fossil fuels while providing living wage jobs to underserved communities. The term clean energy is used to identify sources of energy production that do not contribute to the production of greenhouse gases that drive global warming. Clean Energy includes Photovoltaic, Wind, Geothermal, and Nuclear power. Renewable energy is a source that is not depleted when used. Nuclear energy is not renewable because only a finite amount of uranium exists. However, Nuclear power can support the near-term carbon reduction goals and be part of the solution [6].

Why talk about clean energy education now? Awareness of the effects of global warming has become mainstream, driving the need to reduce dependence on fossil fuels. Growth in clean energy technologies and manufacturing increases the demand for graduates trained in these areas. Physical evidence of climate change is evident across the globe in the form of wildfires, drought, severe weather, water scarcity, food scarcity, and rising sea levels, and the socio-economic impacts of these physical effects continue to grow [2].

B. Mixed Methods Research Design:

The mixed method combines qualitative and quantitative research activities to achieve greater insight and removes the limitation of simplified statistical analysis of quantitative data [7]. Mixed methods provide a more nuanced understanding of the research questions by including qualitative analysis qualified by quantitative guardrails [7]. Interviews allow a more comprehensive analysis of clean energy education and the clean energy transition agenda comprising many political, social, and economic forces by analyzing leaders' opinions in the industry, education government, and community. Although more labor intensive, it is a trade-off between managing the proper scope of research and providing enough detail for well-founded analysis and conclusions.

C. Conceptual Framework: Social Justice

This research study is grounded in the transformative paradigm, emphasizing the need to actively engage culturally diverse groups to advance social justice [4]. According to Transformative Theory, research participants should reflect a diverse cross-section of companies and respondents, ensuring representation of the community's socioeconomic and ethnic composition [8]. This study involved various educational institutions, workforce organizations, manufacturing entities, and community partners in a qualitative analysis through interviews.

The interview questions were designed to promote social justice, diversity, and equity; for example, they asked how to collaborate with and recruit candidates in underserved communities in the survey, Appendix A, and the interview, Appendix B [8]. The research examines the potential for social mobility through CE training pathways, equitable access to continuing education (CE) investments, engagement with underserved communities, and placement of candidates in living-wage jobs.

Developing a clean energy workforce education program aligns with New York State's broader initiative under the Climate Leadership and Community Protection Act (CLCPA), enacted on July 18, 2019. Through incremental targets, the CLCPA commits New York to achieving net-zero greenhouse gas emissions by 2050 [9]. It also incorporates environmental justice provisions, ensuring that disadvantaged communities receive 40% of the overall benefits from the state's climate programs [9]. The study's findings present a clean energy training program plan designed to meet the Climate Act's objectives.

II. Survey and Interview Creation

This study encompasses primary data collection, necessitated by its specific focus on clean energy education. Primary data collection involves data collection through surveys and interview material. Two general categories of data collection are primary and secondary.

Research Limitations: some data collection methods, such as online surveys, are limited. The response rate could be limited, and the researcher cannot clarify any questions if the participant finds ambiguity in the survey [10]. Email surveys can be limited by the institution providing the email list or the survey getting filtered out into junk mail and not delivered [10]. The interview method is limited by how many interviews can be conducted and analyzed within the academic year. Acknowledging that geographical (and associated political, social, and other factors) are at play, the author determined that the scope of this study is limited to the five counties of Western New York comprising the Buffalo Niagara Metropolitan area, a specific area with specific clean energy needs and potentials. Evaluation of clean energy training strategies and approaches is limited to the United States in the present paper, and many factors would be distinct in an international context.

A. Survey Creation and Conduct

A web-based survey for this project was created using Microsoft Forms, a web-based application within the Microsoft Office suite that allows users to create and distribute online surveys to collect data through a user-friendly interface. The survey in Appendix A, used questions to measure respondents' self-reported demographics (age, gender, education, title, career field, and race), knowledge about skills, training, hiring clean energy technicians, and opinions and attitudes about substantive issues in the socio-political context of clean energy training and employment.

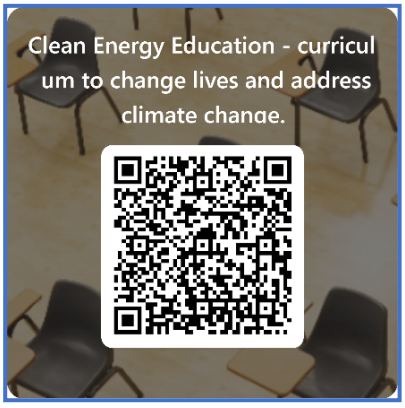

Figure 2. QR Code for Survey Dissemination

Most of the questions involved ranking nominal categories of skills, training topics, and hiring practices, plus some open-ended questions to allow respondents to fill in what might not have been included in the ranking question. The resulting graphic displays are used directly and exported to Excel for further analysis. The use of a QR code to access the survey, shown in Figure 2, in addition to the link, allowed respondents to access the survey instantly, and the data entry occurred automatically from their responses. Additionally, smartphone apps made it possible for respondents not to need to own a computer or log in to participate. As an energy engineering educator in western NY, I chose to invite contacts from representative stakeholder groups such as the members of the Buffalo Niagara Manufacturing Alliance BNMA, the Educational Institutions of Western New York, the SUNY Clean Energy Consortium, the government, and community student success nonprofit organizations. Students, faculty and community members were allowed to take the survey when visiting my research poster at the fall 2024 Research Forum at Buffalo State. Additionally, 125 LinkedIn invites were sent to colleagues in related fields. Anyone from the list who was willing, participated in an online survey to collect the opinions of these groups.

The survey link and instructions were sent to approximately 420 people, (270 via emails sent to BNMA and the WNY CE Consortium, 125 social media messaging, and 25 in person with the QR Code). Although there were no incentives such as payments or prizes, the response size was 72 from 420 invites, making the response rate 17.1%. The questionnaire was designed to improve response rates, for example, keeping the survey under 10 minutes (12:31 final average duration) and keeping a consistent layout.

1) The Survey

A demographic section was included at the beginning of the survey. Then, most of the questions were in the form of a list to be ranked. For example, a list of common objectives and courses to teach those objectives was created. These ranking questions ask respondents to evaluate technical and professional skills, the curriculum to teach those skills, and the recruiting strategies for candidates. Following each ranking question, an open-text question was provided to capture any items that were not provided in the question. The main survey topics were the following:

- What technical skills do your employees or candidates need?
- What professional skills (human interaction) do employees or candidates need?
- What curricula/topics are desired for training employees or candidates in technical skills?
- What curricula/topics are desired for training employees or candidates in professional skills?
- What strategies can be used to recruit candidates in underserved communities?
- What incentives can be offered to recruit candidates, such as hire, then training, and a sign-on bonus?

The complete 23-question survey is presented in Appendix A.

2) Survey Demographics of 72 Survey Respondents

The following demographic details emerged: One limitation of the survey is that 81% of the respondents were men, speculatively because of the age and work sectors of manufacturing and engineering that dominated the survey respondents. The status question showed that 77% were employed, 13% were students, and 9% were retired (see Figure 3).

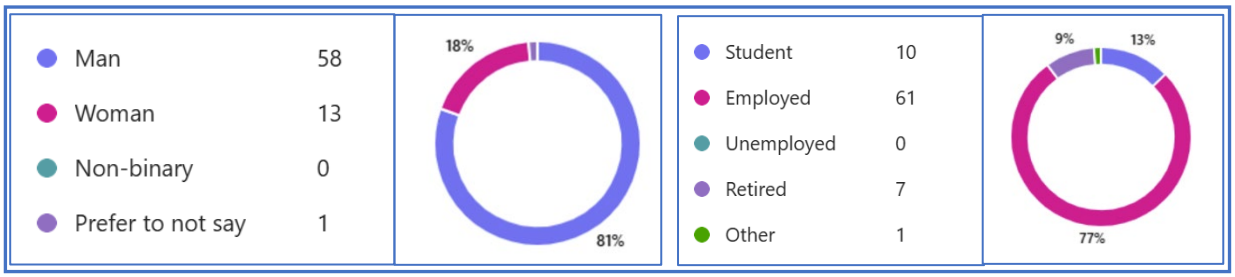

Figure 3. Pie Chart of Gender and Status Frequencies, N = 72 Respondents

Relative to Figure 4, age demographic, 39% of respondents were over 55, 32% were between 36 and 55, and the remaining 29% were 18 to 35. One respondent pointed out that "The questions posed should be modified to bracket the new-hire entry level to the industry as technician level non-AAS (Associate of Applied Science) or BS (Bachelor of Science or Technology), AAS graduate, and BS or BT graduate." Similarly, an AAS student noted that the associate degree was not a selection in the education level question.

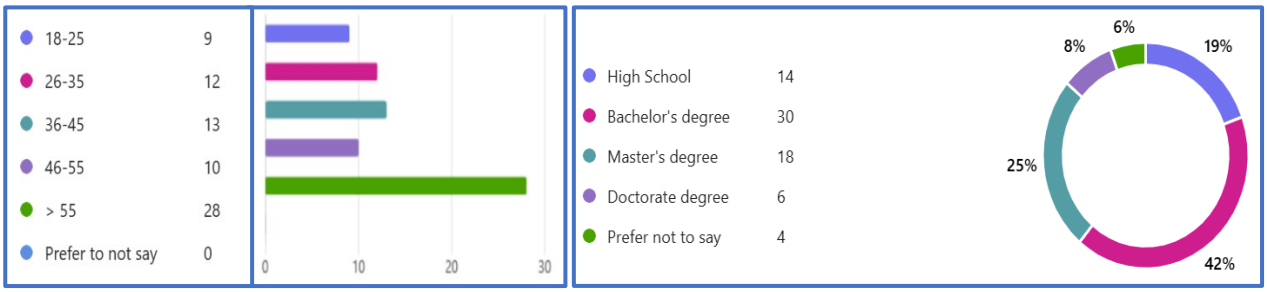

Figure 4. Chart of Age Frequencies and Education Level, N = 72 Respondents

Engineers were heavily represented based on the job title and industry sector of Figure 5.

Figure 5. Word Cloud of "Job Title", N=72 Respondents

There was acceptable coverage of the target groups of industry, education, government, and community. However, a category named community support may have helped the nonprofit organizations have a selection besides ‘other’ for better clarification.

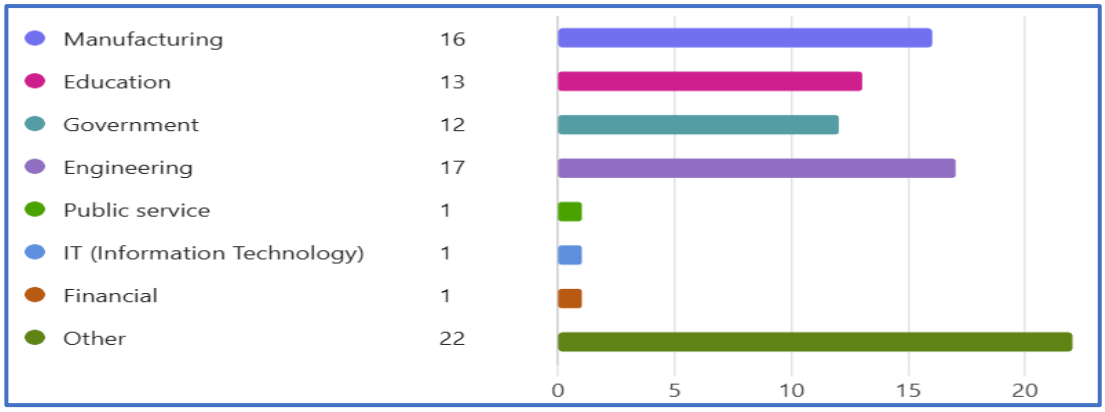

Figure 6. Bar Chart of Industry Sector, N=72 Respondents

In Figure 7, another limitation of representation was noted in that of the 72 respondents, 85% were white, even though the survey request was sent to approximately 420 people, as well as

allowing new respondents that stopped at the display at a Research Forum, to participate.

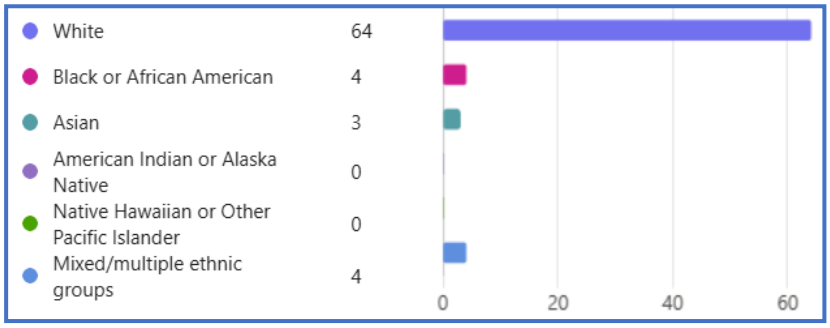

Figure 7. Bar Chart of Race/Ethnicity, N = 72 Respondents

B. Interview Creation and Analysis

An initial approach to developing interview questions is selected to align with the researcher's philosophy and positionality. However, more questions emerge as research proceeds, and different theories or lenses are more appropriately applied. Researchers must avoid cognitive dissonance, "when a person's core belief is challenged internally, and the individual has difficulty mentally reconciling the contradiction" when hearing participants' opinions [11].

1. Interview Creation and Demographics

Interview questions in Appendix B focus on implementing New York's CLCPA clean energy funds, connecting to disadvantaged communities, training and recruiting candidates, and collaboration strategies for cooperation between the government, education, community, and the private sector to get the CLCPA initiatives started [12].

The second research sample is interviews with key stakeholders from clean energy companies, community support organizations, government, and education and training partners. The analysis looks for a correlation between the results of interviews and surveys. The transcripts of this group are analyzed using Computer Assisted Qualitative Data Analysis Software (CAQDAS), such as Delve. Delve coding software assisted in efficiently organizing and analyzing transcript data while deriving meaningful conclusions instead of analyzing data manually, with pen and paper [13].

Interviewees are representatives of the government, private sector, community organizations, and educational institutions collaborating to provide clean energy education and training to disadvantaged communities. Study participants hold a range of ages greater than 18, and their gender and racial identities were not selection criteria. Table 1 summarizes the title, sector, and type of institution of the 13 interview participants. Face-to-face and Microsoft Teams interviews were conducted, then the interview data was transcribed, coded, and de-identified.

2. Analysis: Coding Schemes Identified and Applied to Interview Transcripts

Theory: On qualitative content analysis, Hsieh and Shannon describe three distinct approaches, Conventional, Directed, and Summative Content Analysis, that mainly differ on "coding schemes, origins of codes, and threats to trustworthiness" [14]. The raw interview transcripts are coded for qualitative research. The Directed Content Analysis method aligns with the technical training data of this research. Proper analysis begins with choosing the right approach to qualitative coding by looking for patterns in the data. Codes can be selected based on previous work or understanding, or emerge from the transcripts.

Participants: Thirteen key stakeholders, in Table1, from these representative groups completed an interview to share their opinions regarding the desired attributes, curriculum, and clean energy training program implementation.

Table 1. Summary of Interview Participants

Interview	Title	Sector	Type of Institution
1	President and Founder	Energy Research	Nonprofit
2	CEO	Renewable Energy Installation	Commercial
3	Director of Training	Battery Technology Manufacturing	Commercial
4	Program Director	Energy Education	Public University
5	Dean	Engineering & WF Development	Public College
6	Chief Sustainability Officer	Education	Public Administration
7	Director Of Manufacturing	Light Machining Parts Fabrication	Commercial
8	Director of STEM	Education	Private university
9	Director	Community Energy	Commercial Tech Startup
10	Department Chair	Education	Public University
11	Manager	Electric Utilities	Commercial
12	Department Chair	Education	Public University
13	Program Manager	Manufacturing and R & D	Commercial

Coding Described: The transcripts of this group were analyzed using Delve. In Saldana's coding manual, he presents different types of theories and techniques for analytic coding [11]. Distinct codes are created from the transcript texts, and related codes are grouped into categories. To clarify the terminology, a code is a short phrase that symbolically represents a portion of the interview transcript, a pattern is when a phrase appears repeatedly and can be named as a category, finally a theme organizes a group of similar categories, named for what the group means

[11]. Saldana's book has an appendix B, which suggests coding techniques for the types of research they best fit [11]. Researchers should read the full transcript before choosing a type of first-cycle coding scheme.

First Cycle Coding: Saldana describes, "First Cycle methods are those processes that happen during the initial coding of data and are divided into seven subcategories" [11]. First-cycle coding converts the data into codes and the codes into categories; *Elemental Methods* was chosen for the first cycle because it is a focused filter for reviewing the content. The analysis assembles the answers from each question, looks for common ideas, then groups the answers by similarity. The code is named for a word or a noun that encapsulates the contents of that batch of qualitative data. The subsequent rounds of analysis used two types of Elemental Coding as appropriate; first *In Vivo* coding extracts single words or phrases verbatim in the transcript, and second *Descriptive* Coding summarizes the content of the text into a description.

Second Cycle Coding: Second cycle coding takes the categories and combines them into themes and concepts that help the researcher find meaning and correlate to questions and theories. Second-cycle analysis used Cumulative Coding methods involving the Pattern Technique, to fit similar categories into larger categories or themes [11]. Lumping categories into larger batches, or "theming the data", is done to winnow down the number of themes into an integrative theme by grouping related ideas and eliminating redundancy [11]. The researcher carefully chooses the wording to construct deeper and more cohesive results. Finally, a coherent narrative on meaningful themes and conclusions for clean energy education are derived.

3. Reflexivity and Thematic Analysis of Qualitative Data

As researchers, we play an integral role in the data collection during qualitative studies and actively influence the study outcome. Reflexivity shifts part of the focus onto the researcher [11]. They must examine their judgments, practices, and belief systems during interviews and analysis [11]. A key component of reflexivity is to avoid personal beliefs that affect the research and avoid bias. Thematic analysis involves an active process of reflexivity, where a researcher's subjective experience plays a central role in making meaning from data [15]. Further, thematic analysis is a flexible approach, easy enough for novices, and enables researchers to generate new ideas and conclusions from the data. The challenge is that there are many different ways to interpret meaning from the data set. Since thematic analysis focuses on finding patterns across interviews, it is important not to miss insightful findings appearing in only one account.

The thirteen raw interview transcripts were coded utilizing a relatively new computer-assisted qualitative data analysis (CAQDA) software product from Delve [13]. The conclusion narrative is found by reading through the transcripts and identifying patterns in meaning across the data to derive themes [11]. CAQDA software enhances the ability to organize a large amount of collected data, saving time and assisting the researcher in evaluating the interview files. Initial codes were

revised through additional rounds of second-cycle coding to turn codes and categories into the final set of themes (see Figure 8).

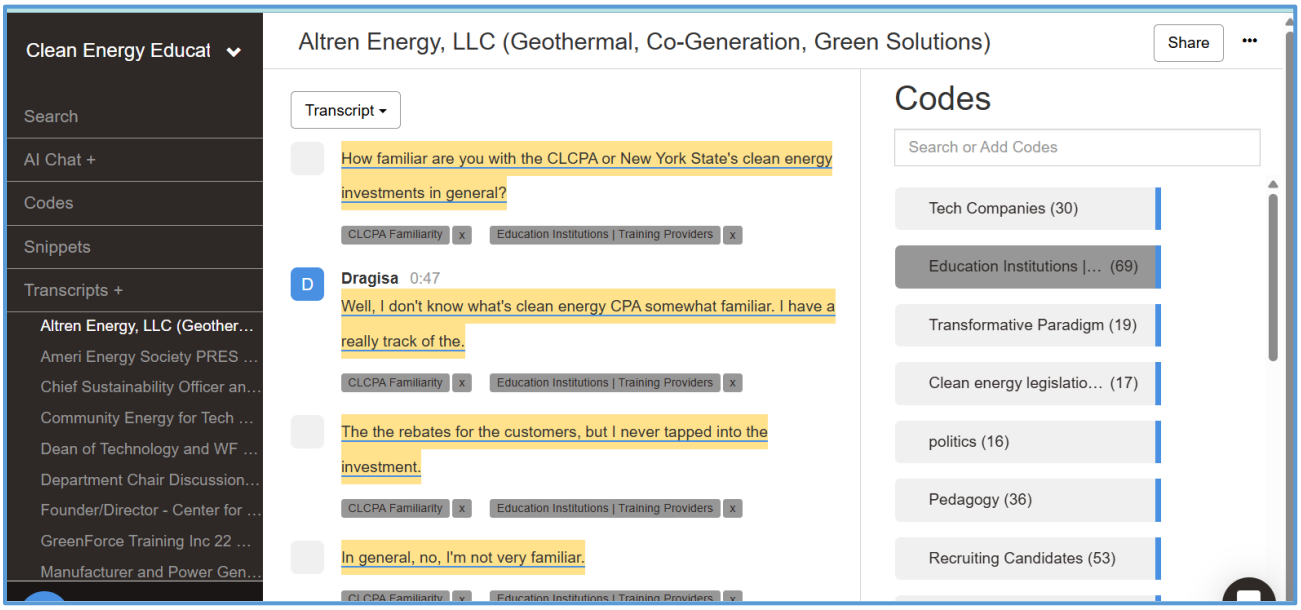

Figure 8. Screenshot of DELVE™ Project for Transcript Coding [13].

The transformative theory is reflected in the questions on the strategies and initiatives to recruit candidates from underserved communities, and transcript analysis was done with an emphasis on the point of view of people from underserved communities in determining how to craft the clean energy training program. Grouping related codes into categories and combining categories into identified meaningful themes during reviews ensured consistency and validated the data and themes across the thirteen interviews.

III. Results that Emerged from Combined Surveys and Interviews

Several important technical, political, and societal themes emerged from the preliminary coding of the clean energy interview discussions. The output themes that emerged were Teaching Techniques, Strategies and Initiatives, Training Topics, Recruiting Candidates, Skills Required, Relevance, Collaboration of Stakeholders, Clean Energy Mix, Politics, Training Providers, Investments, and Pace of Implementation. Additional coding rounds added categories, including Clean Energy Legislation, Climate Change Action, History, and Transformative Paradigm.

The next step of analysis requires the researcher to derive pertinent quotes from the transcripts that support or illustrate each of the themes that came from common opinions among the 13 stakeholders. When combined with the survey results a stronger consensus of the findings was discovered.

A. Clean Energy Curriculum for Technical Skills

The series of questions first determine what skills were expected of candidates, and secondly how these skills would be taught, in the form of training topics or curriculum.

1) Key skills from the interview: From the thirteen transcripts, several key skills are highlighted as essential for technicians in the clean energy sector and related fields, as evidenced by multiple quotes from participants.

Technical Skills: A Department Chair stated, "Some of the things these technicians need to know, are mechanical aptitude, math and science knowledge, basic calculations." Knowledge in areas like HVAC, electrical systems, fluid mechanics, and refrigeration is also emphasized." An Energy Company CEO said, "Well, it is understanding basic physics. You know, electricity, mechanics, fluids. Some of them have training in refrigeration. My company pays for the EPA certification for the refrigerant. HVAC-exposed technicians are pretty good to begin with. I would like to have a workforce to have a deeper understanding of why they are doing what they are doing rather than just following the steps that are training steps.". A Manufacturer and Power Generation professional said, "know some electrical and mechanical and chemistry, the chemistry is important."

Transferable Skills: The ability to transfer skills from one area to another is highlighted. According to the energy project director, "If I were a wind turbine technician, I want to be confident that those skills are portable to other industries." A society president said, "That is a common theme; the skills must be transferable to other sectors." A focused effort to look for skills common to many industries is required.

Safety Training: Understanding safety practices is repeatedly mentioned as a vital requirement in the clean energy field. One clean energy project director said, "Safety training is a given requirement, and I guess it needs more reinforcement or maybe opportunities for people to gain that training before they even walk in the door." Industrial environments must operate with safety first. In the training program, the inclusion of Occupational Safety and Health Administration or OSHA training can be a common treatment of this topic.

Problem Solving: General problem-solving abilities are essential, as technicians often need to troubleshoot and resolve issues.

Hands-On Experience: Practical experience with tools and equipment is necessary for technicians to familiarize themselves with their work environment. A Workforce Trainer said, "To create more familiarity with the product, you could break it down to the actual product process that you are trying to build to teach what you are trying to do." Apprenticeship theory supports this practical hands-on experiential approach.

The interview opinions align well with the survey in Figure 8, with agreement on problem-solving, mechanical, electrical, technology, and product-specific aptitudes. In addition, the skills need to be transferable to other technician disciplines.

2) **Key skills from the survey:** The survey used several ranking questions to discern which skills and topics were most important. Ranking questions are analyzed in quantitative surveys using the software in the platform (Microsoft Form), which assigns numerical ranks to each response based on their order and then calculates the number of times it was ranked in each of the six positions. If multiple respondents give the same ranking to an option and the percentage is the same, the Tied Ranks are ordered by the larger number of 1st and 2nd choices when calculating ranks. The full survey is in Appendix A.

Key Technical Skills and Ranking: The consensus of respondents is that the most important skill was problem solving and troubleshooting, additionally quality and safety, mechanical, electrical, technology-specific, and industrial tool use are needed (see Figure 9). In addition to each ranking question, a follow up single line text question, "What topic if any, wasn't offered in the previous question? Where do you rank it?", was included to capture ideas that were not offered in the rankings.

Figure 9. Ranked Bar Chart of Desired Technical Skills to Support Candidates

Respondents may answer open-ended questions differently from structured equivalents. These follow-up questions with unstructured text answers can contain valuable information but are challenging to analyze. The sample size of 72 provides more robust insights when analyzing open-ended text responses. Including this information with the structured question can improve the analysis. Techniques like thematic analysis could be used to code text responses into categories based on their meaning, but coding is time-consuming, and subjective [11]. Coding of the open text responses can be a future effort to revisit the data. However, for this data set, the single-line responses were cleaned (Removed irrelevant information like repeated words, incomplete sentences, or obvious errors), and an initial read-through was conducted. After each follow-up question, a word cloud was created to illustrate the answers. The size, and boldness, indicate how common a response was. Not all answers were visible in the word cloud, so the "other" findings are listed as words or illustrative quotes in Appendix C.

In Figure 10, Word Cloud of "Other Skills", in addition to the visual skills, some important opinions were also shared. Respondents wanted to add additional skills and the ranking. Included are several important highlights.

Figure 10. Word Cloud of "Other Skills"

A scientist added "1 Science and evidence-based critical thinking and design of experiments (DOE), 2 Communication, 3 Teamwork, 4 Industry-specific exposure ". An educator added "Interpersonal skills, i.e. communication abilities, interacting/getting along with co-workers and supervisors, being an active/reliable team participant."

One respondent said, "The survey questions cloud the difference between knowledge (something I know) and skills (something I'm able to do)" and another wrote, "Safety is always the starting point, especially since clean/renewable energy project work can expose employees to both DC and AC electrical hazards, requiring an understanding of AC/DC machines, AC generating system operation, and power electronics." A manufacturer wrote "1. Ability to read engineering drawings (blueprints), 2. Basic computer skills (Xcel, Word, Bluebeam or Adobe), and 3. Ability to understand and apply specifications related to the work scope." Note that this section dealt with desired skills, the next section determines what classes or topics would deliver those skills.

B. Curriculum and Training Topics:

1) Interview Curriculum Findings: Based on the transcripts, several important training topics emerge regarding workforce training and development in the clean energy sector.

Hydrogen and Renewable Energy: There is a focus on the developments in hydrogen as a fuel for transportation and industry, highlighting its significance in the clean energy landscape. The Clean Energy Project Director mentions that work in this area continues despite not being selected for federal hydrogen hub competition.

Career Exploration in Offshore Wind and other Renewables: Initiatives such as renewable energy manufacturing and career exploration programs emphasize the importance of understanding job roles and components related to offshore wind and other renewable sectors. Additionally, outreach efforts to disadvantaged communities to promote awareness of career opportunities in clean energy are crucial for inclusiveness. A Clean Energy Project Director said,

"Our offshore wind project mission was to share information about offshore wind career and training opportunities with folks from disadvantaged communities."

Training Requirements and Curriculum Development: The need for a structured curriculum, from high school to workforce training, is highlighted. This curriculum includes knowledge in mechanical aptitude, math, and science. The Department Chair said, "determine a curriculum program that covers the spectrum from high school, workforce training and degrees."

Safety and OSHA Training: Training programs often require OSHA certifications, such as hazard communications, personal protective equipment, fall protection, respiratory protection and bloodborne pathogens. OSHA has10-hour basic, and 30-hour in-depth programs that focus on safety regulations, particularly in the manufacturing and energy sectors [16]. An Energy Company CEO said, "The requirement for them (high school students) to even be with us working. Is that they have to go through OSHA training."

Skills Portability is Important: The ability to transfer skills between different roles in clean energy, such as solar installers to wind turbine technicians, is emphasized to enhance workforce adaptability and resilience in the face of changing industry demands.

These "Training Topics" collectively underscore the need for comprehensive training programs that address technical skills, safety, inclusivity, and the evolving landscape of clean energy technologies.

2) **Survey Curriculum Findings:** Desired technical curriculum for candidates as determined by the 72 respondents to the online survey. As shown in Figure 11, technical math, specifically the ability to take measurements with instruments, basic electricity, shop tools, renewable specifics,

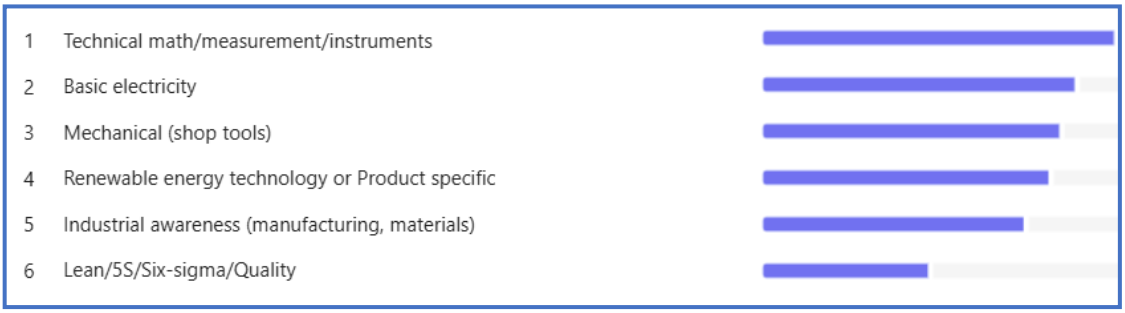

Figure 11. Ranked Bar Chart of Technical Curriculum Topics

industrial awareness and lean Six Sigma skills are to be taught. Interview comments confirmed that 'renewable technology specific' and 'industrial awareness' are desired topics. The other comments indicate an emphasis on energy infrastructure and the impacts to the environment and an appreciation for sustainability. Of note also is the appreciation that heating, ventilating, air conditioning, and refrigeration or HVAC/R gives an excellent foundation for a clean energy technician.

In addition to the word cloud in Figure 12, some important opinions were also drawn. Respondents wanted to add the following curriculum topics and ranking: Add "Systems Integration, 3", and "Certification or licensed in the specific task". A power engineer wrote

Figure 12. Word Cloud "other" Technical Curriculum

"Design engineering ranked 3 to include "Energy infrastructure and the net environmental impact of sources for energy production and Energy distribution systems 4" and "How does use of a specific clean energy tool/application help the environment and the respective process in general? a 5". Another added "I would have some type of communications (reading, writing, project management) training" and "cross training electrical/electronics/mechanical and system interrelations." Multiple respondents added "Physics, Chemistry, HVAC/R". A sustainability officer added "Building automation systems" and "basic understanding of climate and infrastructure; look at the Institute for Sustainable Infrastructure". A power plant manager wrote "The best technicians that I've had the pleasure of working with, were able to read and interpret electrical control drawings and also control logic diagrams. Therefore, subject matter that covers those drawings, as well as digital control logic functions and/or Allen Bradley PLC logic should be added to the curricula."For "Skills Required" overall, a blend of technical knowledge, professional skills, and practical experience is essential for success in the clean energy workforce.

C. Professional (Human Interaction) Skills: Ranking and Curriculum to Support That

1) From the Interview: The paragraphs denote consensus on what the desired professional skills for candidates should be, from the 13 interviews.

General Employability Skills: This includes showing up on time, dressing appropriately, and having reliability, which is fundamental to workplace success. Clean Energy Project Director said, "It can be general employability skills showing up on time, being dressed and ready." A workforce trainer said, "I will tell you, the most important thing we hear is simply, are they going to show up?"

Professional Skills: Professional interaction skills, including communication (eye contact, firm handshake) and teamwork, are critical. The importance of intellectual curiosity and being open to ideas is also noted.

2) From the Survey: Desired Professional Skills

The question often posed is, can professional skills be taught? Many of these are expected of a new hire. But today's young candidates may not have these skills. Figure 13, illustrates the importance, as ranked from most important to least, is reliability, communication, teamwork, safety awareness, professional interaction and financial literacy.

Figure 13. Ranked Bar Chart of Desired Professional Skills for Candidates

Although ranked last, a workforce trainer indicated that financial literacy was important for new workers to understand their benefits and have skills for life. In addition to the word cloud of Figure 14, some important opinions were also drawn.

Figure 14. Word Cloud of "other" Professional Skills

Respondents wanted to add: “As before, interpersonal skills are critical in every job where you need to interact with people. No matter how much you know, or how many skills you have, missing the ability to work with people, even those you dislike, is the difference between success and failure. Perhaps this was intended to be covered in the Teamwork skill but I think it is important enough to be on its own." The ability to adapt and be open-minded when it comes to changing industry priorities, is a valued professional trait.

"It’s sad to have to include this, but in the real world having some background knowledge of office politics and the ability to manage “perception” are critically important. Therefore, a survey class that includes the Myers Briggs Personality Type Indicator tests and guidance on how to deal with various types should be included. Both written and verbal communication skills and financial literacy are important aspects that will help carry employees throughout their careers, but are not as critical in the new-hire stages aside from good interviewing skills.”

As before the professional skills are determined, and the next section, 3, describes how the desired professional skills would be taught, and what curriculum would cover them.

3) Desired Professional Skills Curriculum for Candidates Ranked in order of Importance

These topics of professional skills are not normally included in technical education programs except safety. There is a misconception that these skills are included in other technical courses. Group projects or interactive labs may develop some of these skills but, the ranked courses of Figure15, were created to ensure the ethical work practices, teamwork, communication, safety awareness, professional interaction and financial literacy skills can all be taught.

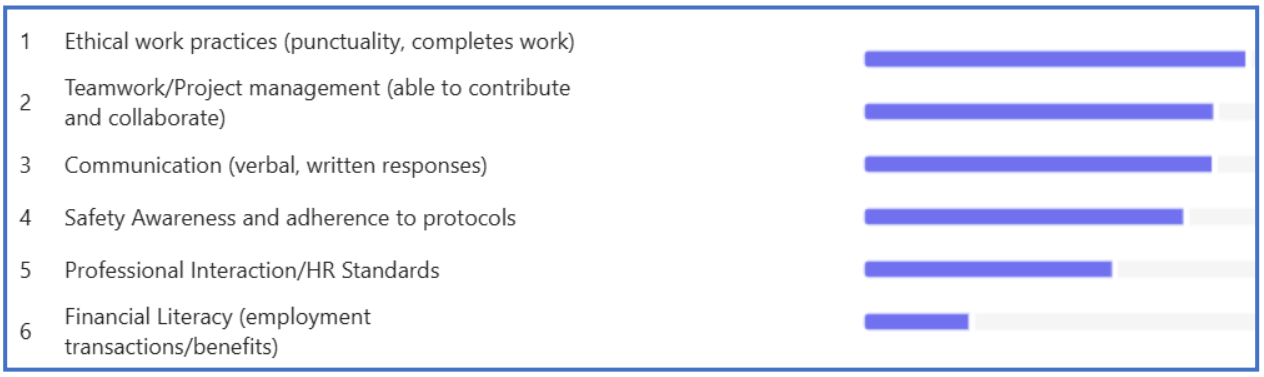

Figure 15. Ranked Bar Chart of Desired Professional Curriculum Topics for Candidates

In addition to the word cloud of Figure 16, some important opinions were also drawn. Respondents wanted to add "Time Management skills", "Speaking up if something is not right ranked 3". A detailed comment requires an answer: "Is it not assumed that curricula topics are directly targeted at developing both technical and professional skills?" The answer is no, professional skills are not part of classic training manuals and curriculum syllabi.

Figure 16. Word Cloud of "other" Professional Curriculum

Instead, using classroom activities, group projects and the conduct of the classroom and laboratory experiences creates the learning of professional skills.

D. Recruiting Candidates: Underserved Communities and The Transformative Paradigm

The transformative paradigm is to remember the underserved members of the community when creating this clean energy program so that it is steeped in thought about upward mobility through training and making a living wage. Upward social mobility is enabled when the individual makes a good wage. Then the family, the community, and ultimately society at large all benefit.

1) Interview Findings on Recruitment

Recruiting candidates and securing employment for them, especially from disadvantaged communities, involves multiple strategies and considerations highlighted in the comments. Here are some key approaches:

Community Engagement: Building strong relationships within the community is essential. This can include participating in community events, job fairs, and partnering with local organizations. For instance, a Workforce Trainer mentions the importance of community engagement in informing people about job opportunities in the clean energy sector: "I think it just comes down to, you know, more community engagement at the end of the day."

Targeted Programs: Establishing programs that specifically focus on underserved communities can help. For example, a Society President discusses the need for visible role models from such communities to inspire others and communicate success stories, "if they've never seen anybody in the neighborhood, go and get a degree or go get a great job. If they never heard anybody come back to the neighborhood and talk about success, working at a company, then how do you get the word out?". Similarly, a Clean Energy Project Director highlights that their initiative aims to provide training and career opportunities in clean energy to disadvantaged groups.

Industry-driven Training and Upskilling: Providing relevant training that aligns with job market needs is crucial. A Clean Energy Project Director emphasizes the importance of getting industry input to ensure that upskilling opportunities are relevant and timely, thus preparing candidates for available jobs.

Streamlined Administrative Processes: Simplifying the application and hiring processes can also help recruit candidates. An Energy Company CEO points out the bureaucratic challenges contractors face when trying to hire from disadvantaged backgrounds "from the standpoint of the contractors. It is very, very cumbersome and it's kind of deterrent because it's not a streamlined process." Reducing paperwork and making the hiring process more accessible can encourage more candidates to apply.

On-the-Job Training (OJT): Implementing OJT programs can be beneficial. An Energy Company CEO notes that while OJT has limitations due to funding, it has been an effective way to train candidates who can then be employed by the companies they intern for.

Collaboration with Educational Institutions: Partnering with schools and colleges can help create pathways from education to employment. A Department Chair discusses the need for a curriculum that supports this transition from classroom to employed.

Focus on Living Wage Jobs: Emphasizing the importance of securing living wage jobs for candidates can motivate both candidates and employers. An Energy Company CEO discusses training individuals in disadvantaged communities for jobs that provide a sustainable income. He notes that "conversion of the houses and living spaces that disadvantaged community members

own is uncommon. If you can frontload help with funding, maybe the community can get projects approved, because in my experience, people who opt for these technologies are well off, who pay taxes and can get the tax write-offs. The people in disadvantaged communities probably do not pay much taxes, so they cannot get tax write-offs."
By combining these "Recruiting Candidates" strategies, organizations can effectively recruit from disadvantaged communities and help them secure meaningful employment.

2) Survey Findings on Recruitment

The survey focused on determining recruiting strategies in underserved communities in terms of outreach and incentivizing candidates. To the question, "Do you recruit candidates for employment or training from underserved communities?" choices were (yes, not directly, no). Respondents said that 36% of the time they do recruit underserved communities while the most common response was not directly, at 47%, indicating that the whole of their recruiting includes some underserved candidates.
To statistically analyze "check all that apply" questions, like the recruiting strategies one, you need to use a method called "multiple response analysis" where each possible answer is treated as a separate variable, allowing you to calculate frequencies, percentages, and cross-tabulations for each option chosen by respondents, even if they selected multiple choices [10]. This typically involves creating a new data set with each answer as a separate binary variable (yes/no) within your statistical software [10]. This was not necessary as the frequency column in Figure 17 shows the frequency of each response option, enough to describe the most commonly used techniques.
Analyzing the relative positions of the strategies within the ranking, *Advertising - social media* and *Public appearances - job fairs, and conferences* tie for the most common strategy at 44 selections, or 28% each. The second most common strategy is *College Visits,* which account for 17% of the total.

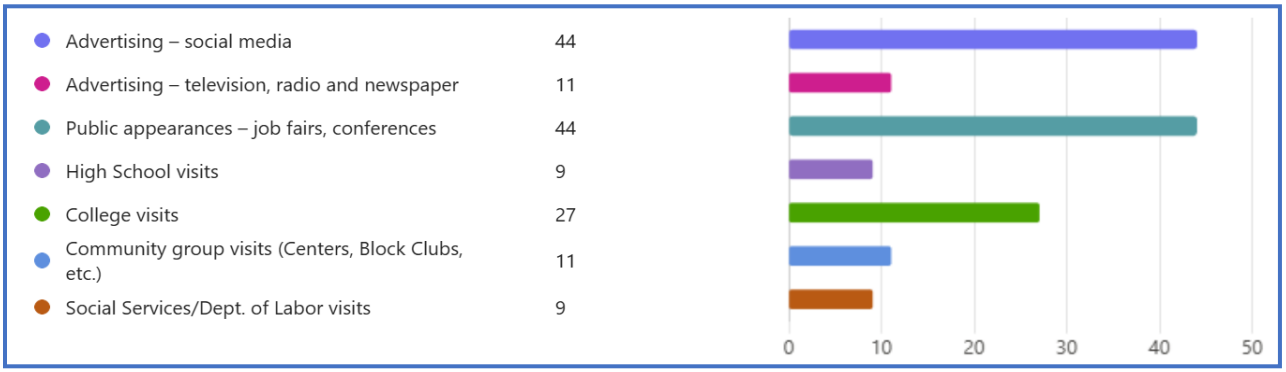

Figure 17. Bar Chart of What Recruiting Strategies are Commonly Used

In addition to the word cloud of Figure 18, some other important recruiting strategies were entered. Respondents wanted to add "use local professional organizations in the field of focus" "Professional colleagues/personal contacts , professional societies." One said "Develop a dedicated apprentice/journeyman/masters program that is independent of a formal school"

"Partnerships with local Workforce Investment Boards/Job Career Centers". "Magnet school showcases, magnet nights meeting with parents and students." “In order to have a candidate from an underserved community become eligible for hire, you need to get them to college first.

Figure 18. Word Cloud of “other” Recruiting Strategies

Therefore, the process needs to start at the high school level, by providing insights on how a disadvantaged person can get to college even if they and/or their parents are low-income. There needs to be a "connect the dots" approach to teaching how to a) perform skills/interest surveys, b) how to find colleges that offer the curricula that the student has interest in, c) outline the application process, d) outline the financial aid process along with the differentiation between work study, grants, loans, and loan payment obligations. A potential student from an underserved community needs to have a vision of the path developed and presented to them, so that in time they can envision how they would fit into that progression. Offer bonus to existing employees who refer a new hire who stays over 90 days". Partnership with a refugee agency and hiring from within.

a) Hiring Incentives in Underserved Communities

The question asked respondents to check all incentives that apply. In Figure 19, the frequency count shows how many times an item was selected, thus a ranking of each emerges. 1. Hire, then on the job training. 2. Hire, then structured training on-site. 3. Paid Internships. 4. Tuition Reimbursement, followed by signing bonuses and more training options.

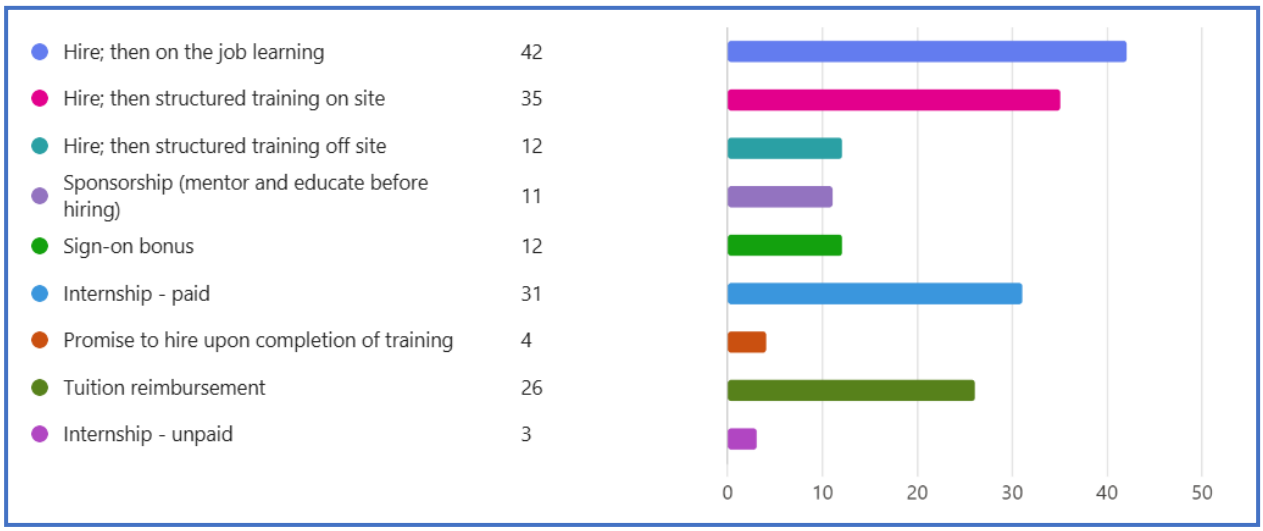

Figure 19. Bar Chart of “What Employment Incentives Do You Provide?”

In addition to the word cloud in Figure 20, some important opinions were also shared. Respondents wanted to add: "Work hour commitment", "Intercollegiate competitions", "Match

Figure 20. Word Cloud of "other" Employment Incentives

current journeyman/master level employees with apprentice level one to one with a dedicated professional development plan", "Good leave policy", "Potential stock options upon completion of training / time with company". "High School readiness program where candidates are working in the field gaining experience and exposure to prepare them for hiring after graduation " "Intern to full time pipeline", "Referral bonuses for existing employees who bring in a good candidate." "Highschool apprenticeship", "Energize program, NYSERDA funded on job training [8]." "Good health care".

IV. Interview Results: Stand-alone Themes

A. Pedagogy (Methods and Practices For Teaching)

The transcripts across various discussions highlight the evolving landscape of education and training, particularly concerning energy sectors and trades.

Multidisciplinary Approaches: There is a strong emphasis on designing multidisciplinary educational programs that cater to the needs of the technology sector, such as electrical, mechanical, and industrial focus. For instance, one speaker noted that their approach is influenced by process improvement, suggesting a need for practical and efficient delivery of relevant topics to prepare students for employment.

Program Flexibility: Various comments indicate a recognition of the need for flexible educational pathways. One speaker suggests that shorter training programs (such as 12-week courses) can effectively prepare individuals for careers in energy rather than requiring lengthy degrees. This flexibility is further echoed in discussions about alternative paths to traditional four-year degrees, especially in trades, which are presented as viable options with potentially higher salaries.

Importance of Guidance: The role of guidance counselors is crucial in shaping students' educational choices and steering them toward practical career paths. There is a concern that the emphasis on four-year degrees may overshadow equally valuable vocational training. A Society President said "The trades may, over time, have a higher salary than the deferred graduate, who

waits four years and spends $100,000 getting the degree." Regarding recruitment into trades, " if you wait until they are juniors and seniors in high school, that path has already been fixed." In the context of higher education, a compromise between trades and college, is the associates of occupational science AOS degree, which removes the additional general education requirements.

Practical Learning and Skills Development: A recurring theme is the need for educational programs to focus on hands-on skills and practical learning. For instance, one speaker emphasized that effective programs should teach students and then require them to demonstrate their knowledge, contrasting it with other educational approaches. The Society President said, "Here's what you need to know. We're going to teach you, and then you'll demonstrate that you have learned it, which is much different than many educational programs."

Internships, Mentorship and On-the-Job Training: OJT is a vital component of workforce training, allowing individuals to gain experience and potentially secure positions after a trial period. A Project Director said, "A big key is having internships, and the idea being, that the OJT is right there, and is sort of a test fit of the intern; you have committed to, you know, two months, and at the end if things have worked out well, you offer them a position." The employer and the intern both benefit even if continued employment is not the end result. The importance of internships as a test fit for new technicians and the role of mentorship in helping new employees integrate into workplace environments are discussed. A workforce trainer said, "So after the initial training, new hires are given a kind of soft handoff to another worker, and then they mentor that person."

Innovation and Climate Solutions: When sustainability is part of technician training, it gives a deeper meaning to clean energy studies. There is a call for research and innovative technologies to address climate change, suggesting a growing intersection between education, technology, and environmental stewardship. A Sustainability Officer said, "Research in sustainability, focusing on developing innovative technological solutions to climate problems, should be scaled up."

Overall, the discussions on "Pedagogy" reflect a collective push towards creating educational frameworks that are adaptable, practical, and responsive to industry needs, particularly in the context of energy and sustainability.

B. Clean Energy Initiatives and Implementation Strategies

Based on the comments from various transcripts, several key strategies and initiatives for advancing clean energy workforce development and addressing community needs can be identified.

Community Engagement and Support: Engaging disadvantaged communities is crucial for inclusive workforce development. The Clean Energy Project Director mentions collaborations with organizations serving these groups to promote career opportunities in renewable energy. A Society President highlights the need for clean energy companies to invest in community

engagement, recognizing that established local companies understand their communities better and can facilitate connections.

Skill Development and Training Programs: There is a strong emphasis on the need for targeted training programs that prepare individuals for specific careers in clean energy. A Clean Energy Project Director said, "People are getting trained right now. And if the jobs do not exist when they are done, then what did we just do? So that comes down to the sequencing". The director discusses the importance of aligning training with job availability and ensuring that upskilling opportunities are timed appropriately with industry demand. Initiatives like the Renewable Energy Manufacturing Career Exploration aim to educate potential workers about job opportunities in areas such as offshore wind and the components needed for these industries. The recurring theme is the availability of employment after training. Therefore, the training should be industry driven.

Coordination Among Training Providers and Industry: Effective coordination between training providers and industry stakeholders is vital. The Clean Energy Project Director notes the importance of industry feedback in shaping training programs and ensuring they meet current job market demands. The Clean Energy Consortium is mentioned as a platform that can help training providers connect with interested businesses and facilitate collaboration.

Government and Funding Support: The role of government in funding and supporting training initiatives is critical. There are calls for more effective use of state and federal funding to support clean energy training programs and to ensure that these funds reach the communities that need them. Mentions of organizations like NYSERDA indicate the importance of leveraging existing resources and programs to enhance workforce training in clean energy.

Awareness and Communication: There is a need for better communication strategies to inform potential trainees about available funding and training opportunities. Integrating information into newsletters and community outreach is suggested to improve awareness. A Project Director said, "One way to improve is just to have some information for various groups integrated into newsletters that are going out to the community, to educators, to industry and so on. I think Chamber of Commerce Partnerships and Public and Private Energy companies have a message they want to send to multiple shared mailing lists." The Department Chair emphasizes the necessity of creating pathways from high school to workforce training, ensuring that students know the opportunities available to them.

Addressing Barriers to Employment: Addressing barriers such as childcare and transportation is crucial for enabling individuals from disadvantaged backgrounds to access training and employment opportunities. As mentioned by a Department Chair, strategies for creating living wage jobs are essential for uplifting communities and ensuring that individuals can sustain themselves while contributing to the clean energy sector.

These suggestions for “Strategies, Initiatives, and Implementation” collectively aim to create a robust pipeline for workforce development in clean energy, ensuring that training aligns with industry needs while engaging and supporting disadvantaged communities.

C. Clean Energy Legislation and Climate Change Action

The transcripts reveal several important points regarding clean energy initiatives, particularly in New York, as well as the challenges and opportunities associated with them:

Clean Energy Goals and Legislation: The Climate Leadership and Community Protection Act (CLCPA) is a central framework driving clean energy efforts in New York, aiming for aggressive greenhouse gas reduction goals and promoting equity in energy distribution. It mandates that 40% of investments benefit underserved communities. Implementation of the mandate will benefit communities while addressing climate change. Significant funding is available for clean energy education and projects, especially at federal and state levels. This includes a focus on job creation and support for disadvantaged communities.

Market Awareness: The importance of staying updated on the current state of clean energy markets and trends is emphasized, with suggestions to engage with local consortiums and manufacturers for real-time insights. A project Director said, “I don't know where the best place is to get the current pulse because the national data is lagging. I often go to ONET and the Department of Labor statistics, but even that is at least a few years old [17]. Check what you see in the newspaper for what is happening right now and stay in touch with local consortiums of manufacturers and other groups.“

Bureaucratic Challenges: The bureaucratic process surrounding clean energy project funding is described as cumbersome, particularly in obtaining rebates and navigating paperwork, and is a deterrent for contractor participation.

Impact of Climate Change: The urgency of addressing climate change is highlighted by references to recent record temperatures and severe weather events, reinforcing the need to transition from fossil fuels. There is a growing presence of solar farms and a general push toward sustainable practices, indicating a shift in public and market attitudes toward clean energy.

Regarding the Clean Energy Legislation, these points collectively illustrate the complex landscape of clean energy in New York, highlighting both the progress and the remaining obstacles.

D. Collaboration of Clean Energy Stakeholders (Educational Institutions, Training Providers, Energy Companies, and Community)

Several strategies can be employed based on insights from the transcripts to foster collaboration among stakeholders.

Promote Communication and Engagement: Engaging stakeholders through direct communication is crucial. As one participant noted, "it just comes down to a full-on community engagement and that's how you get it out". This suggests that proactive outreach and dialogue can build relationships and facilitate collaboration.

Build Partnerships and Collaborative Frameworks: Establishing partnerships between community organizations, industry, and educational institutions is essential. For instance, a participant emphasized the importance of collaboration among "community industry higher Ed and government." By creating an inclusive environment where all parties are involved, stakeholders can find common goals and work together effectively. Developing formal structures or frameworks for collaboration can facilitate ongoing partnerships. This includes establishing coalitions or consortia that bring together various stakeholders to address specific challenges, as seen with organizations like the Clean Energy Consortium (a New York State Education group).

Identify Common Goals: As highlighted in the discussion, having a shared vision or goal can align the interests of various stakeholders. For example, a clean energy initiative emphasizing workforce development can unite different sectors towards a common purpose.

Leverage Existing Networks: Utilizing existing networks can enhance outreach efforts. Engaging with organizations that already have established connections, such as "manufacturing associations," can streamline communication and collaboration. An Energy Company CEO said, “New York Geo, for example, or solar networks, are better informed than the general contractors. Watch what's going on through your local, New York Geo chapter and see if there's a lot of demand, and that demand needs to come from entities that would promote projects to the developers. Private party apartment buildings can get funding from the state, called state apartment buildings, and are looking for contractors who would execute the work, and they would offer them certain funding for it.”

Focus on Training and Development: Providing training opportunities that meet the needs of all stakeholders can create a stronger workforce and encourage collaboration. Training programs involving multiple stakeholders, such as community colleges and industry representatives, can ensure everyone is on the same page regarding skills and needs. A workforce trainer said, “the New Energy New York, to make New York a leader in battery technology and manufacturing, which is the formal group that Binghamton University has put together, anticipates creating 157,000 jobs just in New York State by 2030, and that number goes up to 230,000 new jobs in total related to the industry.” The New Energy program appears to be a successful collaboration to make progress on battery storage manufacturing, a clean energy enabling technology.

Encourage Feedback and Adaptation: Continuous feedback from all involved parties can help refine collaboration efforts. As one speaker noted, "The college does not move fast enough. The manufacturers have emerging markets and needs". This indicates that being responsive to stakeholder needs can enhance collaborative efforts.

By implementing these strategies, stakeholders ("Educational Institutions, Training Providers, Energy Companies, and Community") can work together more effectively, ultimately leading to successful outcomes in their collaborative initiatives.

E. Energy Mix for Decarbonization and the Geopolitical Landscape

The discussion surrounding the energy mix in the political and historical context reveals several key points. Resources are available to learn about the geopolitical energy landscape. Data is available from the American Energy society at www.energysociety.org, the U.S. Energy Information Administration at www.eia.gov, and multiple sections of the U.S. Department of Energy at www.energy.gov. Specifically, the American Energy society has policy papers that shed light on the pulse of the socio economic landscape regarding clean energy and particularly the "Trump Presidency 2.0" [18].

Nuclear Energy Support in Transition to Clean Energy: There is a significant shift towards clean energy sources, with a particular emphasis on the role of nuclear power. There is a belief in the potential for nuclear power to play a significant role in clean energy, with technological advancements that could mitigate past concerns. A Clean Energy Project Director notes that despite nuclear energy being considered clean, it is often met with skepticism from those focused on renewable energy. The Project Director said, "If you're clean energy, you don't want to hear new nuke designs, which are clean, but have other challenges, but from what I understand, there has been some progress made on the challenges at the research level." This sentiment highlights the ongoing debate about accepting nuclear energy within the clean energy movement. A Professor mentions, "I am Pro Nuke... I believe we can engineer our way out of the reservations people have". However, this position is not widely popular among clean energy advocates.

Policy Influence: The political landscape plays a critical role in shaping energy policies. The Inflation Reduction Act and other legislative measures have spurred investments in clean energy technologies, as highlighted by a Sustainability Officer, who mentions, "the Inflation Reduction Act provided investments in domestic battery metal mining". This illustrates how government policies can create opportunities for growth in clean energy sectors. As the US presidency and administrations change, oscillations in program support, whether pro renewable or pro fossil fuel, occur based upon the emphasis of that administration [18]. Many executive orders try to cancel the other side's actions, and cabinet members influence the government's focus, but many incentives are codified in law. The energy markets will move towards profitability, based upon supply and demand regardless of the administration's push.

Historical events, such as the dismantling of the U.S. solar industry in the 1980s under President Reagan, serve as cautionary tales. A Sustainability Officer warns, "That (President) Trump's threats to derail America's clean energy industry can reverse progress", emphasizing the potential long-term economic consequences of undermining clean energy initiatives.

Global Competition: There is a competitive dynamic in the global clean energy market, particularly with countries like China leading in solar and wind energy production. A Society President notes that "The Chinese government has installed more Photovoltaics than the entire rest of the world combined", indicating that the U.S. must remain vigilant and proactive in its clean energy strategy to avoid losing its competitive edge.

The Energy Mix for Power Generation: The energy mix is increasingly recognized as not just a binary choice between fossil fuels and renewables but as a composite of various sources, including nuclear, solar, and wind. A Clean Energy Project Director mentions the need for technicians to have a "view of all of the clean energy mix", Figure 21 [19] for united states energy consumption by type, underscoring the importance of a wholistic approach to energy generation.

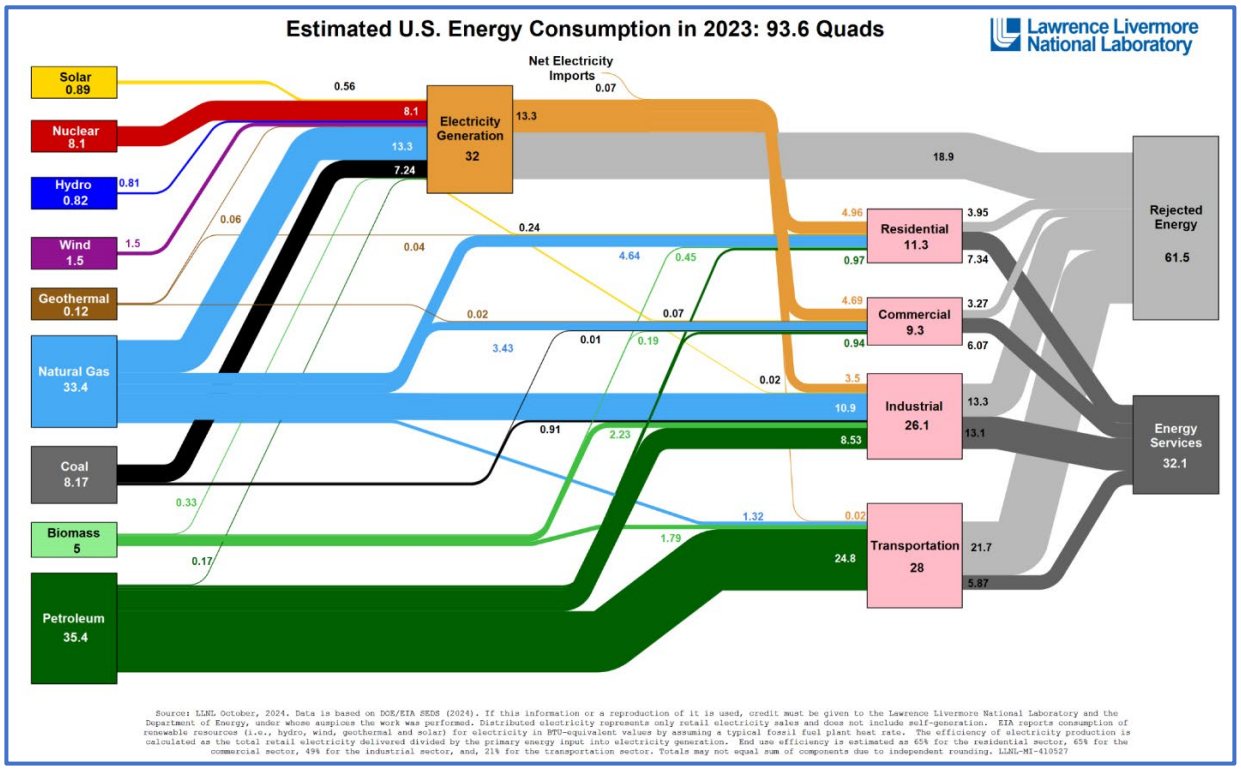

Figure 21. U.S. Energy Consumption 2023 by Energy Source [19]

These points reflect a complex interplay of political, economic, and historical factors that shape the current and future energy landscape in the U.S.

V. Summary and Conclusion

This section summarizes and compares the survey and interview results from both outputs, and the recommendations for establishing a Clean Energy training program are based on the data collected from employers. Market-driven job expectations reveal the technical and professional skills desired by the industry. The preceding results section provides detailed elements for deeper discussion beyond this summary. For skills required overall, a blend of technical knowledge, professional skills, and practical experience is essential for success in the clean energy workforce.

Technical and Professional Skills and Curriculum

Consensus on key skills such as problem-solving and troubleshooting, quality and safety, mechanical, electrical, technology-specific, and industrial tool use were found. The existing curriculum covers these technical skills well, affirming that foundational topics such as technical math, measurements with instruments, basic electricity, shop tools, renewable energy specifics, industrial awareness, and quality skills are to be taught. Employers expect candidates to have reliability, communication, teamwork, safety awareness, professional interaction, and financial literacy skills in the context of desired professional skills. The consensus is that interpersonal skills are essential in every job where you interact with people. Additionally, a curriculum must ensure that ethical work practices, teamwork, communication, safety awareness, professional interaction, and financial literacy skills can all be taught, as summarized in Table 2.

Table 2. Summary of Top 10 Technical and Professional Skills and Curriculum

	Technical Skills	Curriculum	Professional Skills	Curriculum
1	Problem-solving and troubleshooting	Technical math, measurements, instruments	Reliability (punctuality, completes the work)	Ethical work practices (punctuality, completes work)
2	Quality and safety	Basic electricity	Communication (verbal, written responses)	Teamwork & Project management (able to contribute and collaborate)
3	Mechanical	Shop tools and their use	Teamwork (able to contribute and collaborate)	Communication (verbal, written responses)
4	Electrical	Renewable Energy Technology or Product specific	Safety awareness and adherence to protocols	Safety awareness and adherence to protocols (OSHA)
5	Technology or Product specific	Industrial - manufacturing, materials	Professional interaction and HR Standards	Professional interaction and HR Standards
6	Industrial tool use	Lean/5S/Six-sigma/Quality	Financial literacy	Financial (employment transactions, benefits)
7	Data Analysis using Computer Programs	Data Analytics	Adaptability and perseverance	Time Management skills
8	Computer Aided design	Computer Aided design	Curiosity, independent thinking	Organization skills
9	Innovation, creativity	Basic Chemistry	Cultural appreciation and awareness	Ability to speak up, Self advocacy
10	Risk assessment & management	HVAC and Refrigeration	Self-awareness and personality traits	Regulatory and Compliance knowledge

Employer's assume that curriculum topics directly address both technical and professional skills, however, most traditional curricula address the information, not the professional skills. It requires a focused effort to include activities such as group projects and group lab experiences to work on those human interaction skills.

The minimum employability skills are showing up on time, dressing appropriately, being ready to work, following through, and time management. Professional interaction skills such as communicating clearly, making eye contact, a firm handshake, and teamwork are also important. Personal integrity is desired, such as doing the right thing regardless of who is watching and speaking up if something is not right.

Recruiting

In the context of recruiting candidates, there is an emphasis on community engagement. Participating in public events, job fairs, and fundraisers in the community can help reach candidates in disadvantaged neighborhoods. Survey respondents said they directly recruit candidates for employment from underserved communities 37% of the time and indirectly 47% of the time. If the expectation was that employers are actively seeking candidates in underserved communities, then the 37% statistic would be disappointing (Figure 22). One way to improve underserved community focus is by looking at a Stored Energy company that has embraced the community in which it operates on the east side of Buffalo, New York.

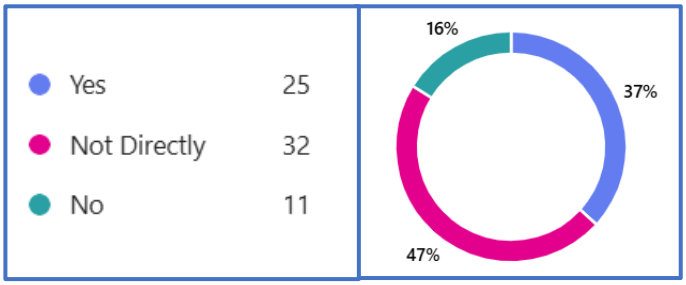

Figure 22. Pie Chart of Recruiting Candidates in Underserved Communities

The Battery Company Example: Viridi Parente makes smart distributed energy storage battery systems, delivering safe and scalable on-demand power in place of diesel generated power, contributing to decarbonization and a sustainable future [20]. What sets them apart is a deep commitment to economic equality and environmental stewardship. To facilitate this, the company started a recruitment and training division called GreenForce, which offers a comprehensive Production Associate Training program designed to equip participants with essential skills to understand the clean energy sector, and experience the manufacturing environment in which they will work [20]. The GreenForce director said, "If you look nationally at production associate job entry statistics, 10% of those jobs are people of color. At Veridi, it's 90% so, we were able to flip the script on that", as shown in Figure 23, [20]. Veridi behaves as a regional team player, citing that "trainees that leave for other companies in the area is a good thing for Western New York, as it's a shared workforce anyway". The GreenForce director went on to say, "I consider our training

to be a significant piece of the climate change industry and we will continue to adapt our training as the industry continues to adapt".

Figure 23. GreenForce Production Associate Training Statistics 2023. [20]

Without community events, employers and educators can collaborate to create targeted programs and set up events to start the engagement process. Providing relevant training that aligns with job market needs is crucial. When opportunities are relevant and timely, candidates have a chance to find available jobs. Recruitment strategies included social media advertising, public appearances at job fairs and conferences, and high school and college visits. The hiring incentives included on the job training, on-site structured training, paid internships, tuition reimbursement, and signing bonuses.

Pedagogy (Methods and Practices for Teaching)

In the context of methods and practices for teaching, programs are expected to be multidisciplinary and flexible regarding duration and format, like stackable credentials. Many interviewees stressed the importance of guidance counseling. Young candidates need a lot of information to determine what trades or classic college education path is appropriate. A recurring theme is the need for educational programs to focus on hands-on skills and practical learning. Internships for new technicians and the role of mentorship in helping new employees integrate into workplace environments are important for both intern and employer. Finally, including sustainability and the environment in technician training gives a deeper meaning to clean energy studies. Overall, the discussions on "Pedagogy" reflect a collective push towards creating educational frameworks that are adaptable, practical, and responsive to industry needs, particularly in the context of energy and sustainability. The desired characteristics of a quality clean energy education program are summarized in Table 3.

Table 3. Top 10 Recommended Characteristics of a Clean Energy Program

	Recommended Characteristics of a Clean Energy Program
1	Provides hands-on experience with tools and equipment. Uses an experiential apprenticeship approach (teach, demonstrate, assist, then watch the student).
2	Trainers are certified in industry-recognized credentials. Training is industry-driven and provides upskilling and on-the-job training for returning students.
3	Takes a multidisciplinary approach to curriculum. Covers mechanical and electrical aptitude, math, physics, chemistry, science, and problem-solving.
4	It begins with community engagement and support, as well as collaboration with industry, educational institutions, and community organizations.
5	Considers the transferability of skills to other clean energy sectors and job market awareness (of opportunities upon completion) for the skills being taught.
6	Considers heating, ventilating, air conditioning, and refrigeration, HVAC/R as an excellent foundation for clean energy skills. HVAC/R can be certified by existing apprenticeship and EPA certificates.
7	Includes industrial awareness and safety, with occupational safety and hazards administration (OSHA) training as a foundation.
8	Is flexible by programming different trades, skill levels, duration, and stackable credentials.
9	Explores careers and topics in multiple sectors of clean energy: renewables, photovoltaic, wind, offshore wind, hydrogen, and others.
10	Promotes student success by including mentoring and having wrap-around services available to address barriers to participation when necessary.

Advancing clean energy workforce development requires the recurring elements of community engagement and industry-driven targeted skill training with government and educational support. Addressing the barriers of childcare, transportation, essential food, clothing, and shelter needs is crucial to enable individuals from disadvantaged backgrounds to participate. There is an additional need for better communication strategies to inform potential trainees about available funding and training opportunities.

Legislation and Policy

To advance clean energy legislation and climate change action, affected stakeholders should stay current on the state of clean energy markets and trends by engaging with local consortiums and manufacturers to stay informed. Specifically in New York, the CLCPA, as a central framework driving decarbonization, requires proactive communication and application to the funding streams. To foster collaboration among stakeholders (educational institutions, training providers, energy companies, and community), we need to build partnerships and leverage existing networks to coordinate outreach efforts and assist partners with administrative processes to leverage government support.

One of the biggest challenges is governmental red tape, in funding a new program and facility at a public college, there is the inertia of trying to get contractors and consultants hired. In the author's experience, there are multiple handoffs between departments such as safety and risk management, the purchasing department, finance, and grants coordinator. All of these factors together equal months of delay. Addressing the common training needs of all stakeholders would create a more substantial workforce development program.

The Larger Policy Landscape - Nationally. Getting clean energy education to work in non-clean energy legislated states will require collaboration among the leaders of manufacturing and utility companies so that clean energy can allow companies to achieve their bottom line while still supporting climate change action and clean energy technology [21]. It will take grassroots effort by manufacturers, nonprofit organizations, professional societies and agencies like Catholic Charities, Goodwill Industries, boys and Girls Club and educational opportunity programs (EOP) to advocate for clean energy technology education to match industry needs [22]. I advocate future research on the regulated and deregulated states clean energy policies to determine if these dissertation recommendations could be replicated in other states.

The energy demand is constantly increasing, and the energy mix that generates electricity covers a broad spectrum. The shift towards clean energy sources reveals that the use of photovoltaic and wind energy is incremental, and the power source is intermittent. Energy production is not just a binary choice between fossil fuels and renewables; it is a mix of various sources, including nuclear, solar, and wind. Decarbonization efforts will be advanced significantly if the role of nuclear power is included. Nuclear power with newer, safer designs is slowly gaining acceptance in traditional public opinion, which is characterized by fear and disapproval of nuclear power.

Regarding U.S. government policy, the energy markets will move towards profitability, based upon supply and demand, regardless of the administration's push. A collaborative effort should be made to perform a needs and gap analysis to identify the current workforce demand in each skill type and identify currently available training. Meeting the demand for clean energy workforce positions is a significant effort. The wind energy industry employs more people than the coal industry, and the solar industry employs more people than the oil and gas sectors combined [3].

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Appendix A: Clean Energy Education Survey Questions

Clean Energy Education - curriculum to change lives and address climate change.

My research goal is to improve the educational opportunities for current and future technicians who work in clean energy industries. The technical training must be designed to prepare clean energy program students for energy sector jobs. Providing training pathways gives the potential for successful placement and social mobility. This study aims to answer the overarching research question: As understood by Clean Energy Education Stakeholders (clean energy manufacturing sector, educational institutions, government and community leaders) in New York State:

1. What is the most efficient Clean Energy training/educational method to develop a student into an employment-ready clean energy technician or engineer?

2. How can career pathways for new entrants in Clean Energy be made accessible to disadvantaged communities?

Section 1

Demographic Information

All of your information is highly confidential and for internal use only. Please contact us if you have any concerns.

1.By agreeing to participate in this study, you are agreeing that: You are at least 18 years old. Your participation in this research is entirely voluntary. You agree to participate in X research, and that he has permission to record your responses during this survey and use the information for his research.[Don't hesitate to contact the investigator, X, at x or X. If you have any questions concerning your rights as a subject, contact X.Required to answer. Single choice.

I agree

I disagree

2.What gender do you identify as? Required to answer. Single choice.

Man

Woman

Non-binary

Prefer to not say

3.What is your age? Required to answer. Single choice.

18-25

26-35

36-45

46-55

> 55

Prefer to not say

4.Which will best describe your status? Required to answer. Multiple choice.

Student

Employed

Unemployed

Retired

5.What is your role or job title? Single line text.

Enter your answer

6.What industry are you employed in? Multiple choice.

Manufacturing

Education

Government

Engineering

Public service

IT (Information Technology)

Financial

7.What is the highest level of education you've completed? Single choice.

High School

Bachelor's degree

Master's degree

Doctorate degree

Prefer not to say

8.What race/ethnicity would you consider yourself as? (Select one or more): Multiple choice.

White

Black or African American

Asian

American Indian or Alaska Native

Native Hawaiian or Other Pacific Islander

Mixed/multiple ethnic groups

9.We plan to invite some participants to join part 2 of this research using a 15-question interview. If you're willing to participate, please provide your email address and so that we may contact you later. Thank you. Multi Line Text.

Enter your answer

Section 2

Clean Energy Sector specific questions on skills, training and recruitment

10.What Technical Skills (mechanical, electrical and shop floor type skills) do your employees or candidates need? (Please Rank them in order of importance 1 (most) through 6) Ranking.

Mechanical
Industrial/tool use
Electrical
Quality and Safety
Problem-solving/Troubleshooting
Technology or Product specific

11.What Technical Skills do employees or candidates need, that wasn't offered in the previous question? On a scale of 1 (most important) to 6 where do you rank it? Multi Line Text.

Enter your answer

12.What curricula and topics are desired/essential for training employees or candidates in Technical Skills (Topics to be included in a robust clean energy training program)? (Please Rank them in order of importance 1 (most) through 6) Ranking.

Mechanical (shop tools)
Basic electricity
Technical math/measurement/instruments
Industrial awareness (manufacturing, materials)
Renewable energy technology or Product specific
Lean/5S/Six-sigma/Quality

13.What curricula and topics on Technical Skills do employees or candidates need, that wasn't offered in the previous question? On a scale of 1 (most important) to 6 where do you rank it? Single line text.

Enter your answer

14.What Professional Skills (human interaction and employment ready behavior) do your employees or candidates need? (Please Rank it in order of importance 1 (most) through 6). Ranking.

Reliability (punctuality, completes the work)
Professional Interaction/HR Standards
Safety Awareness and adherence to protocols
Teamwork (able to contribute and collaborate)
Communication (verbal, written responses)
Financial Literacy

15.What Professional Skills (human interaction and employment ready behavior) do employees or candidates need, that wasn't offered in the previous question? On a scale of 1 (most important) to 6 where do you rank it? Single line text.

Enter your answer

16.What curricula and topics are desired for training employees or candidates in Professional Skills? (human interaction and employment ready behavior) (Please Rank them in order of importance 1(most) through 6). Ranking.

Ethical work practices (punctuality, completes work)
Professional Interaction/HR Standards
Safety Awareness and adherence to protocols
Teamwork/Project management (able to contribute and collaborate)
Communication (verbal, written responses)
Financial Literacy (employment transactions/benefits)

17.What curricula and topics in Professional Skills do your employees or candidates need, that wasn't offered in the previous question? On a scale of 1 (most important) to 6 where do you rank it? Single line text.

Enter your answer

18.Do you recruit candidates for employment/training from underserved communities? (yes, not directly, no) Single choice.

Yes

Not Directly

No

19.What Strategies do you use to recruit candidates in general? Select all that apply. Multiple choice.

Advertising – social media

Advertising – television, radio and newspaper
Public appearances – job fairs, conferences
High School visits
College visits
Community group visits (Centers, Block Clubs, etc.)
Social Services/Dept. of Labor visits

20.Of these recruiting strategies, which are most effective in recruiting candidates from underserved communities? (Please Rank them in order of effectiveness 1 (most) through 7; based on your experience). Ranking.

Advertising – social media
Advertising – television, radio and newspaper
Public appearances – job fairs, conferences
High School visits
College visits
Community group visits (Centers, Block Clubs, etc.)
Social Services/Dept. of Labor visits Other

21.What Novel Strategies do you use to recruit candidates that were not included in the previous question? On a scale of 1 (most effective) to 7 where do you rank it? Single line text.

Enter your answer

22.What employment incentives, if any, do you provide for potential employees? (Select all that apply) Multiple choice.

Hire; then on the job learning

Hire; then structured training on site

Hire; then structured training off site

Sponsorship (mentor and educate before hiring)

Sign-on bonus

Internship - paid

Promise to hire upon completion of training

Tuition reimbursement

Internship - unpaid

23.What novel employment incentive ideas could you use to recruit candidates that were not included in the previous question? Single line text.

Enter your answer

Appendix B: Clean Energy Education Interview Questions

1. How familiar are you with the CLCPA or New York State clean energy investment in general?

2. Do you consider your institution a member of the clean energy sector? Are you actively working on any Climate Leadership and Community Protection Act (CLCPA) elements?

3. How relevant is the CLCPA to your business or institution's goals and operations?

4. What workforce training topics do you think are needed for Clean Energy technicians?

5. What are some challenges or barriers to finding good candidates to hire, or to enter training; in general and specifically from disadvantaged communities?

6. Where do you think candidates can get the proper training to support clean energy job openings?

For questions 7, 8, & 9: if you are not an employer, what do you think of the ideas?

7. Would you be willing to collaborate with state/local government to contract training for employees?

8. Do you use on-the-job training for new employees? Or what do you think of OJT for new technicians?

9. Do you require qualifications prior to hiring, and if so, what are they? Or what do you think of required clean energy qualifications before hiring?

10. What Strategies do you think are needed to get the CLCPA scoping plan initiatives (Technician training and community investment) started?

11. How do you currently connect with training providers as a Clean Energy sector-related business? How can the process be improved?

12. How does the State (NYSERDA/funding entities) currently connect with Clean Energy businesses? How can the process be improved?

13. How does the State (NYSERDA/other funding entities) currently connect with training providers? How can the process be improved?

14. How do training providers currently get the information out to disadvantaged community candidates? How can the process be improved?

15. What is the biggest challenge in making these CLCPA initiatives happen? The biggest opportunity?

Appendix C: Clean Energy Education Survey Open Text Responses for “Other”

From Figure 4. "Job Title" Word Cloud, Additional Responses, N=72 Respondents

"Program Manager "
"Health care surgical consultant . RN , independent LLC "
"PhD Metallurgical and Materials Engineering"
"Sr Managing Director"
"Researcher"
"System Engineer"
"Retired Naval officer"
"President/ COO"
"Product Engineer"
"Sales director "
"Senior Sales Executive"
"Product Engineering Lead"
"Professor "
"Sales consultant"
"Process Engineer"
"Speech-Language Pathologist / Educator"
"Tooling Design Engineer"
"Business Owner"
"7-12 science teacher, biology, chemistry, environmental science."
"Civil Engineer"
"Prior to retirement - Self-employed business owner"
"Program Manager"
"Contracted Consultant in the role of Electrical Commissioning Engineer - Lead"
"Project Finance Manager"
"Research and Development Engineer"
"Mechanical Engineering and drafting"
"Principal Engineer"
"Sustainable Design Engineering Student at University of Prince Edward Island"
"Contractor "
"Executive Director - Thermal Power"
"Operations Manager"
"Chief Operating Officer- Housing Services & Real Estate Development Organization "
"Sr Scientist"
"Stationary Engineer (SE2/RO3)"
"Retired Salesman "
"Sr. Engineering Analyst"

"Corporate Education Manager "
"Owner"
"Facilities Systems Engineer Supervisor"
"Logistics Manager"
"Exe university Director, SHEQ Compliance & Assessment (retired)"
"Multi Family & Small Commercial Community Energy Advisor"
"Project Manager "
"Project Manager"
"Energy and outreach specialist"
"Mechanical engineering intern"
"Steelworker"
"President, CEO"
"Restaurant worker"
"Machinist"
"Chief Sustainability Officer"
"Electrician "
"Electrician "
"Business Development Executive "
"Electrician "
"Electrician "
"Estimator "
"Project Manager"
"Electrical Engineer"
"Mechanical Engineer"
"Director - Mission Critical Design "
"Vice President of Operations"
"Maintenance Technician "
"Higher Ed Administration "
"Assistant Director of Civic and Community Engagement"
"Associate Professor "
"Librarian"
"Associate professor "
"Dean"
"Lecturer"

From Figure 9. Word Cloud of "Other Skills" Additional Responses, N=72 Respondents

In addition to the word cloud, some important opinions were also determined. Respondents wanted to add the following technical skills and the ranking.

"Risk management, 2"

"1.big picture awareness of all aspects of the project, no silo function 2.ownership drive regarding the task they do. not just doing the job"
"1) Science/evidence based critical thinking and design of experiments (DOE)"
"Teamwork, 3"
"Industry specific exposure 4"
"You have covered thew top 6"
"Communication. Between 2 and 3"
"Determining the proper tool/device for application needed… 1"
"My field is semiconductor specific, thus those interested would need to possess an intricate understanding of process development- Dry/Wet Etch, PVD, Lithography, Chemistry "
"Interpersonal skills, i.e. communication abilities, interacting/getting along with co-workers and supervisors, being an active/reliable participant of a team."
"Risk assessment "
"None"
"I'm not sure if this qualifies as a technical skill but interpersonal skills would be ranked number 1 in my business. The survey questions cloud the difference between knowledge (something I know) and skills (something I'm able to do)"
" 1) Supply and Logistics 4) Legal and Regulatory Training 3)Public Relations/Communications 2) Emergency Response"
"1. Ability to read engineering drawings (blueprints). 2. Basic computer skills (Xcel, Word, Bluebeam or Adobe). 3. Ability to understand and apply specifications related to the work scope."
"Innovation, creativity, and the ability to create new tools to make the process more efficient ranked 3"
"2 Data Analysis using Excel (Ranks w/ Problem-solving/Troubleshooting because you can use Excel to problem-solve and troubleshoot)"
"Computer Aided design 3"
"Since I work in a consulting engineering firm serving the power generation industry, the above responses were not applicable to hires into E3 Consulting. Therefore, I responded to what would be needed for entry-level hires into clean energy or renewables and will target the rest of my responses accordingly. Safety is always the starting point to progress from, especially since clean/renewable energy project work can expose employees to both DC and AC electrical hazards. However, an understanding of AC/DC machines, power electronics, AC generating system operation, are also required. The questions posed should be modified to bracket the new-hire entry level to the industry as 1) technician level (non AAS or BS), 2) AAS graduate, and 3) BS/BT graduate."
"N/A"
"Sanitation, HACCP, GMO, GHS, CCP"
"Technology, AI, "
"Instrumentation & Controls systems"
"Sales training "

"BPI certification (Building Performance Institute)"
"Hands on mechanical along with an Engineering degree is preferred."
"To be able to summarize difficult technical problems and present them to others well."
"People skills, communication skills, etc"
"Communication skills Ranked 3"
"Computer/software tool familiarity, 2"
"n/a on question 10 - less technical more programmatic skills, education,"
"Basic computer software knowledge I would rank it #3"
"Using tools"
"Communication 2"
"Communication skills, 4"
"Soft skills -- curiosity, ability to research, teamwork, leadership. However, I am reading the question above as pertaining to my own employees, who work in an office"
"Team cooperation skills"
"None"
"Labeling and communicating "
"Team Collaboration "
"Revit or AutoCAD proficiency "
"Problem solving skills"
"21st Century skills"
"Critical skills like data analysis "

From Figure 11. Word Cloud "other" Technical Curriculum, Additional Responses, N=72 Respondents

"Systems Integration, 3"
"Certification or licensed in the specific task"
"Energy infrastructure and the net environmental impact of sources for energy production"
"Energy distribution systems 5”
"I would have some type of communications (reading, writing, project management) training"
"You have covered the top 6"
"How does use of a specific clean energy tool/application help the environment and the respective process in general? Top 3"
"Physics, Chemistry"
"1. Interpersonal skills, i.e. communication abilities, interacting/getting along with co-workers and supervisors, being an active/reliable participant of a team."
"Risk assessment "
"None"
"Can't think of one"
"1) Logistics "
"1. CAD"

"Design engineering ranked 3"
"Product life cycle management , Microsoft excel “2”"
"The best technicians that I've had the pleasure of working with, were able to read and interpret electrical control drawings and also control logic diagrams. Therefore, subject matter that covers those drawings, as well as digital control logic functions and/or Allen Bradley PLC logic should be added to the curricula."
"Basic chemistry - 4"
"HVAC/R"
"Cross training electrical/electronics/mechanical and system interrelations"
"Building automation systems"
"Read technical writing and drawings. "
"English/Writing/Foreign Languages, 3"
"n/a"
"Basic understanding of how things work common sense"
"1"
"Communication, 4"
"Basic understanding of climate and infrastructure -- look at the Institute for Sustainable Infrastructure"
"On site troubleshooting (2)"
"None"
"N/a "
"HVAC design "
"Technical "
"Data Analytics"

From Figure 13. Word Cloud of "other" Professional Skills, Additional Responses, N=72 Respondents

In addition to the word cloud, some important opinions were also drawn. Respondents wanted to add the following:
"Effectiveness, 4"
"Teamwork needs to include working with diverse team members "
"Adaptability {6}"
"You have covered the top 6"
"None"
"None"
"As before, interpersonal skills are critical in every job where you need to interact with people. No matter how much you know, or how many skills you have, missing the ability to work with

people, even those you dislike, is the difference between success and failure. Perhaps this was intended to be covered in the Teamwork skill, but I think it is important enough to be on its own."
"Legal and Regulatory Compliance"
"Innovation mindset"
"2-3 Adaptability - The ability to adapt and be open minded when it comes to changing industry"
"Follow through - 1"
"It's sad to have to include this, but in the real world having some background knowledge of office politics and the ability to manage "perception" are critically important. Therefore, a survey class that includes the Myers Briggs Personality Type Indicator tests and guidance on how to deal with various types should be included. Both written and verbal communication skills and financial literacy are important aspects that will help carry employees throughout their careers but are not as critical in the new-hire stages aside from good interviewing skills."
"N/A"
"Ethics Integrity "
"Interview preparation--probably near the bottom of the list"
"Cultural appreciation/awareness, 4"
"Willing to work more than 40 hours a week and sacrifice time for company #4"
"Technical skills in general"
"Organization, 4"
"Curiosity, ability to research and learn, independent thinking, initiative"
"Compliance (3)"
"None"
"N/A"
"Self-awareness "
"Diversity, Equity and Inclusion"

From Figure 15. Word Cloud of "other" Professional Curriculum, Additional Responses, N=72 Respondents

In addition to the word cloud, some important opinions were also drawn. Respondents wanted to add the following:
"all of the above"
"Time Management skills"
"None"
"None"
"Can't think of any but want to add that ranking the above in any order does not adequately reflect their importance - all are essential "
"Regulatory and Compliance"
"Speaking up if something is not right ranked 3"
"N/A"

"There is a considerable amount of redundancy in the questions, almost to an irritating level. Some differentiating statements to frame the difference between curricula topics, technical skills, and professional skills would be helpful and refinement of such would yield better results from the survey. Is it not assumed that curricula topics are directly targeted at developing both technical and professional skills?"
"N/A"
"Likable #2"
"Hands on tools"
"Organization, 4"
"n/a"
"None"
"N/A"
"Teamwork"
"DEI"

From Figure 18. Word Cloud of "other" Recruiting Strategies, Additional Responses, N=72 Respondents

In addition to the word cloud, some important opinions were also drawn. Respondents wanted to add the following:
"Local professional organizations in the field of focus"
"Professional colleagues/personal contacts , professional societies "
"Professional Networks #1"
"Develop a dedicated apprentice/journeyman/masters program that is independent of a school"
"Placement Agencies: Recruiters"
"Partnerships with local Workforce Investment Boards/Job Career Centers"
"Referrals and/or "reach out" to companies who have successfully used this service, SB owners directly targeted, personal/professional referrals. all in the 4-6 range"
"Employee referral (1) "
"Magnet school showcases, magnet night meetings with parents and students."
"I would only hire a candidate who already has all the necessary skills and has experience demonstrating success in using them"
"Company Culture"
"I have never been in the need to recruit candidates."
"N/A"
"Referring "1""
"Word of mouth -1"
"The consulting firm that I work for targets folks that have already become successful in their energy discipline, and therefore the aspect of recruiting the underserved is not applicable. However, to have a candidate from an underserved community become eligible for hire, you need

to get them to college first. Therefore, IMHO, the process needs to start at the high school level, by providing insights into how a disadvantaged person can get to college even if they and/or their parents are poor. There needs to be a "connect the dots" approach to teaching how to a) perform skills/interest surveys, b) how to find colleges that offer the curricula that the student is interested in, c) outline the application process, d) outline the financial aid process along with the differentiation between work study, grants, loans, and loan payment obligations. A potential student from an underserved community needs have a "vision" of the path developed and presented to them, so that in time they can envision how they would fit into that progression."
"N/A"
"Internships through colleges"
"Offer bonus to existing employees who refer a new hire who stays for at least 90 days"
"I did not answer questions 20 as I have no personal experience with it."
"Word of mouth #3"
"Word of mouth, circles of family and friends"
"On job training programs"
"n/a"
"None"
"N/a"
"Recruiter "
"Partnership with refugee agency"
"Higher education journal"
"Hiring within"

From Figure 20. Word Cloud of "other" Employment Incentives, Additional Responses, N=72 Respondents

In addition to the word cloud, some important opinions were also drawn. Respondents wanted to add the following:
"Work hour commitment"
"Intercollegiate competitions"
"Match current journeyman/master level employees with apprentice level one to one with a dedicated professional development plan"
"Questions 18-23 are difficult to answer as I do not directly recruit. So, my knowledge is very limited"
"None"
"The last few questions are more relevant to hiring managers, I am an engineer and do not have insight/ responsibility on the matters of hiring/ recruiting. Being a federal employee, we do not hire/ advertise for my team in the ways industry would. My answers are my own and in no way reflect that of the US government or my agency, I do not speak or provide answers on behalf of my agency, and all information is personal opinion."

"Can't think of one"
"Good leave policy"
"I have never been in the need to recruit candidates."
"N/A"
"Product/Brand awareness"
"Potential stock options upon completion of training / time with company"
"For the first two decades of my career, I took advantage of off-site training seminars. But in the context of helping those from underserved communities, I think a percentage matching contribution towards paying off accumulated student loans would provide significant incentive."
"N/A"
"High School readiness program where candidates are working in the field gaining experience and exposure to prepare them for hiring after graduation "
"Intern to full time pipeline"
"Referral bonuses for existing employees who bring in a good candidate."
"Highschool apprenticeship "
"Energize programmed, NYSERDA funded on job training"
"Health care"
"None"
"N/a"