The Value of Embedding Industry Certifications in Your College Program: The Electric Vehicle Case Study

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Abstract: T he rapid growth of the electric vehicle (EV) industry demands a skilled workforce equipped with relevant certifications. This study, conducted by three National Science Foundation (NSF) Advanced Technological Education (ATE) centers, the Center for Renewable Energy Advanced Technical Education (CREATE), Clemson University, and the National Electric Vehicle Consortium (NEVC), explores the alignment between industry certification offerings in community college EV programs and the actual needs of the EV industry. The research aims to understand whether these programs integrate certifications that meet current industry standards or if third-party, paid organizations, or legacy agencies disproportionately influence the certification landscape.

Through a mixed-methods approach, including surveys, focus groups, and interviews with community college educators, industry stakeholders, and certification bodies, the study evaluates the accessibility, relevance, and inclusivity of these certifications. The findings reveal a significant gap between the certifications offered by community colleges and those preferred by employers in the EV sector. It was also observed that third-party organizations often drive certification requirements, which may not always reflect evolving industry needs.

The research concludes with recommendations to bridge the certification gap, emphasizing the need for closer collaboration between industry and educational institutions, the standardization of certification requirements, and implementing strategies to reduce socio-economic barriers. These findings have critical implications for shaping the future of EV workforce development, ensuring that certifications are not only industry-relevant but also equitable and accessible to all aspiring technicians.

Keywords: electric vehicle, electrification, charging station, energy storage, battery storage, electrical infrastructure, electrician, technician, STEM education

Introduction

The EV Industry

The electric vehicle industry is undergoing rapid transformation, driven by advances in technology, evolving consumer demands, and global efforts to combat climate change [1]. However, this growth has

been characterized as the "wild west" of industrial change, a space of dynamic opportunities and significant challenges [2]. While new players and technologies emerge, the lack of standardization in training, certifications, and workforce development has created uncertainty for both educators and employers [3].

The demand for a skilled EV workforce has grown exponentially, requiring the rapid development of new career pathways that transcend traditional professional disciplines [4]. Legacy sectors such as electricians, electronic technicians, and automotive technicians now intersect with emerging fields like battery manufacturing, fleet management, emergency response, cybersecurity, and energy distribution [5]. This overlap creates unique challenges for educators and employers alike. While many of these career pathways were once siloed within distinct educational programs, the rise of electrification requires a multidisciplinary approach that bridges gaps between these disciplines [6]. Traditional educational systems, which often take years to develop and adapt programs, struggle to keep pace with the rapid evolution of industry demands [7].

NEVC Background

The National Electric Vehicle Consortium was established to address these challenges through a collaborative effort funded by a National Science Foundation grant. NEVC's mission is to build a national framework for EV workforce development by bringing together academic institutions, industry stakeholders, and certification bodies to discuss the needs of the space, explore current educational offerings, and, where needed, help to create standardized pathways into the electrification workforce. The grant supporting NEVC seeks to foster a national conversation that examines best practices, identifies workforce gaps, and responds to the evolving needs of the industry. This collaborative effort aims to unify fragmented programs and establish clear certification and training standards to ensure alignment between academic and industry goals.

Among the key goals of the NEVC grant are to:

- Facilitate networking: Establish a nationwide network of academic and industry partners to collaboratively address workforce needs, share best practices, and identify gaps in training.
- Develop standards: Identify common certifications and competencies that align with industry needs across diverse sectors, including manufacturing, automotive repair, energy infrastructure, and cybersecurity.
- Anticipate future needs: Create flexible frameworks that can adapt to the rapid changes in the electrification landscape.

By fostering a national dialogue, NEVC serves as a bridge between education and industry, helping to streamline the development of new programs and certifications while ensuring that all stakeholders: educators, employers, and policymakers, are aligned in preparing the next generation of the EV workforce.

CREATE Energy Center, an NSF ATE Center—The mission of the CREATE Energy Center is to provide a skilled technical workforce for the energy sector. The Center was founded over two decades ago as a regional organization focused on educating STEM technicians in California. Since that time, the Center has expanded its reach to all fifty states and three U.S. territories. CREATE has addressed a wide variety of energy technologies, including: biomass and biofuels, wind, solar, hydro, and nuclear power, electrical generation, transmission and distribution, and supervisory controls and data acquisition technology [8]. Most recently, CREATE has expanded its study to include energy storage (ES) and the electrification of the transportation sector. The Center has also conducted a series of international studies to explore how other countries have approached education and training for the energy sector, including an examination of the types of credentials and certifications used internationally for emerging energy technologies [9].

Clemson University, along with its partners Trident Technical College, Greenville Technical College, and Spartanburg Community College, is developing a cross-disciplinary workforce pipeline for the EV manufacturing and service industry. A faculty-led consortium of two and four-year institutions, industry leaders, and ATE centers is working to create and pilot digital learning content designed to enhance technician education and training [10]. The project integrates virtual and augmented reality (VR/AR) into hybrid curricula, providing immersive, interactive learning experiences for students and incumbent workers [11].

As part of this effort, we have developed 63 lessons tailored for EV manufacturing and service technicians, ensuring that learners gain relevant skills for the evolving industry. This also includes the creation of eight hybrid instructional materials, including VR/AR simulations, designed with insights from industry, higher education institutions, and research-based teaching strategies to ensure real-world applicability. These modules and courses are currently being field-tested with academic and industry partners to refine content before full implementation. The digital learning tools have been integrated into an upskilling platform (EducateWorkforce.com), expanding access to training resources [11].

State of EV Training

The current landscape of EV training programs reflects the complexity and diversity of workforce demands in the electrification sector. Available training pathways span a wide range of disciplines, from certifications for electricians and electronic technicians to specialized programs for battery manufacturing, first responders, fleet managers, and cybersecurity professionals. Institutions like Weber State University and community colleges such as Shoreline Community College and Rio Hondo College offer targeted programs, while organizations like Society of Automotive Engineers (SAE), National Fire Protection Association (NFPA), and Tesla provide certification pathways such as high-voltage safety, electric vehicle supply equipment (EVSE) installation, and Tesla Start, all of which have various levels of breadth and depth, time commitments, cost commitments, accessibility, and applicability & mobility within the field [12], [13]. We have compiled a modest list of known programs and certifications currently available, which numbers more than 30 distinct offerings, but this is admittedly not an exhaustive catalog, as new initiatives are being launched at a rapid pace.

Despite these efforts, implementing diverse training pathways in traditional educational institutions remains a significant challenge. Legacy institutions are often constrained by established curriculum frameworks that are slow to adapt to new and interdisciplinary demands. Programs that prepare electricians, for instance, may not easily integrate training for high-voltage battery systems, while automotive technicians may lack access to cybersecurity modules critical for modern electric vehicles [14]. The task of aligning such programs under a coherent, uniform pathway is further complicated by the rapidly evolving nature of the electrification industry, where technological advances frequently outpace the educational sector's ability to respond.

In this fragmented environment, there is a pressing need for collaboration between industry and academia to develop a unified approach to training. However, achieving this level of standardization is challenging in a sector that is still maturing and where industry needs are constantly evolving. NEVC's work to identify best practices, foster partnerships, and create adaptive frameworks is vital to addressing these challenges and ensuring that educational institutions are equipped to support the workforce of the future [15].

Methods

Purpose of the Survey

The NEVC launched a national survey initiative as a foundational step to assess the alignment between academic training programs and industry workforce needs in the rapidly evolving EV sector. As the

electrification industry expands, traditional workforce preparation methods are struggling to adapt to the multidisciplinary demands and rapid pace of change. The survey was designed to provide a clear, data-driven understanding of current gaps, priorities, and opportunities in EV workforce development, laying the groundwork for a standardized and industry-aligned approach to training. As is standard in a comparative survey methodology, two parallel surveys, one for academic respondents and one for industry respondents, were administered to gather complementary perspectives.

The Need for the Survey

The EV industry represents one of the fastest-growing sectors in the modern economy, with significant advancements in technology and infrastructure driving unprecedented demand for a skilled workforce. However, the training landscape remains highly fragmented, with programs and certifications that often lack coherence or alignment with employer needs.

Key Factors necessitating the survey include:

1. Fragmented training pathways.
2. The current workforce pipeline for electrification spans a wide range of disciplines, including electricians, automotive technicians, electronic technicians, fleet managers, battery manufacturers, emergency responders, cybersecurity specialists, and energy distribution professionals. Many of these career pathways overlap but lack integration, leaving gaps in how workers are trained and credentialed. This patchwork approach has created confusion for both employers and educators, as no standardized framework exists to guide program development or certification priorities.
3. Industry—academia disconnect.
4. Preliminary evidence suggests that many academic programs embed certifications and curricula that are not aligned with the practical needs of industry stakeholders. For example, employers may prioritize traditional trades, such as electricians or mechanics, with on-the-job experience over specialized certifications. At the same time, academic programs may emphasize credentials that are costly or inaccessible to specific groups. This misalignment has created inefficiencies in workforce preparation and a lack of clarity for students entering the field.
5. Rapid evolution of workforce needs.
6. The electrification sector is marked by rapid technological innovation and shifting priorities. New fields such as energy storage, autonomous vehicle systems, and advanced manufacturing are emerging, while legacy disciplines such as automotive repair are being reshaped by the integration of electric and electronic systems. Traditional educational institutions, which often require years to design and approve new curricula, struggle to keep pace with these evolving demands. The survey aims to provide real-time insights into what certifications, skills, and training pathways are most relevant today and in the near future.
7. Need for a national discussion.
8. The survey also addresses the broader goal of fostering a national conversation about best practices, industry needs, and workforce gaps. By collecting data from educators and employers across the country, NEVC aims to create a shared understanding of the challenges and opportunities in EV workforce development, facilitating collaboration among stakeholders to develop unified solutions.

Survey Objectives:

The survey was designed to achieve the following specific objectives:

1. Identify certification and training gaps.
2. Assess the alignment between certifications offered in academic programs and those valued by industry stakeholders. The survey seeks to uncover where training programs fall short in addressing the skills required for specific roles in the EV sector.
3. Understand industry expectations.

4. Capture the perspectives of employers on the importance of certifications, preferred skill sets, and barriers to hiring in electrification-related roles. This includes exploring which certifications enhance employability, salaries, or career advancement opportunities.
5. Evaluate academic offerings.
6. Explore the scope of certifications embedded in academic programs, the types of careers students are being prepared for, and the challenges educators face in delivering effective training.
7. Provide a baseline for more in-depth qualitative research, including interviews with educators, industry leaders, and students, as well as the analysis of large workforce datasets. This multi-faceted approach aims to build a comprehensive understanding of workforce development needs in the EV sector.
8. Guide NEVC's strategic initiatives
9. Inform NEVC's efforts to develop standardized, accessible, and adaptable training pathways that meet the evolving demands of the electrification industry. The survey results will serve as the foundation for creating actionable recommendations and fostering collaborations between academia and industry.

Survey Design and Approach

The survey consisted of two tailored questionnaires:

1. Academic Survey
   Distributed to educators and program administrators, this survey collected information on the certifications embedded in academic programs, the fields in which graduates are placed, and the challenges educators face in implementing EV training. It also sought to understand where academic programs perceive gaps in available certifications and resources.

2. Industry Survey
   Directed toward employers and industry stakeholders, this survey examined which certifications and skills are most valued in hiring, how certifications impact employment outcomes (e.g., salary or job opportunities), and where employers see gaps in workforce preparation.

Both surveys were designed to gather quantitative and qualitative data, enabling a comprehensive analysis of perspectives from the two key groups driving workforce development: academia and industry. By collecting data on certifications, skill requirements, and perceived barriers, the surveys aim to bridge the divide between these critical stakeholders.

Distribution and Participation Rate

To assess the alignment between academic EV training programs and the needs of industry stakeholders, two surveys were distributed to key participants within the academic and industry sectors. These surveys targeted educators, program administrators, and industry professionals with direct involvement in the training, hiring, and development of EV technicians and related personnel. The surveys were designed to capture a comprehensive picture of how well current academic offerings meet the evolving demands of the electrification workforce, as well as to identify gaps in certifications and training pathways.

Survey Distribution

Approximately 800 individuals were contacted to participate in the surveys, including representatives from community colleges, universities, technical training institutions, and companies operating across various sectors of the electrification space. Survey invitations were distributed through multiple channels, including targeted mailing lists, academic and professional networks, and industry associations. The outreach strategy ensured that participants were drawn from a broad spectrum of stakeholders, ranging from educators involved in EV-focused academic programs to employers representing diverse fields such as automotive manufacturing, energy distribution, fleet management, battery production, and emergency response.

The survey design included two tailored questionnaires:

- Academic Survey: Directed toward educators and program leaders involved in preparing students for roles in the EV workforce. This survey explored topics such as the certifications embedded within academic programs, fields of graduate placement, and the challenges educators face in delivering relevant training.
- Industry Survey: Targeted at employers, hiring managers, and industry representatives, this survey focused on the certifications and skills employers prioritize in hiring, the impact of certifications on job outcomes, and perceived gaps in workforce readiness.

The total number of survey responses received was 126, with 94 responses from academic participants and 32 from industry representatives. Approximately 75% of participants were from the academic sector, reflecting the significant role that educational institutions play in shaping the EV workforce pipeline. The breakdown of responses is as follows:

Table 1. Survey Response Rate

Survey Group	Total Contacts	Responses (n)	Response Rate (%)
Academics	~520	94	~18.1%
Industry	~300	32	~10.6%
Total	**~820**	**126**	**~15.4%**

While response rates varied between the two groups, the overall response rate of ~15.4% is consistent with survey-based studies of similar scope in educational and workforce research. Academic participants were primarily educators from community colleges, universities, and technical training programs, representing a variety of disciplines related to electrification, including automotive technology, electrical systems, energy infrastructure, and manufacturing. Industry participants included employers from EV manufacturing, energy distribution, fleet operations, and associated sectors. (Note: while the overall response rate is provided to indicate general participation, it should not be interpreted as a unified metric of survey validity. Since the academic and industry surveys were separate instruments with different items relevant to the intended respective audience, overall participation is included as a descriptive measure to indicate total participation in the study's integrated research framework.)

Characteristics of Respondents:

- Academic Participants: Represented educators and program administrators involved in developing and delivering EV-related curricula, certifications, and training. These respondents provided insight into the certifications embedded in their programs, the challenges they face in integrating multidisciplinary training pathways, and their perceptions of gaps between education and workforce needs.
- Industry Participants: Included hiring managers, workforce development specialists, and executives from companies across the electrification sector. Their responses reflected the certifications and skill sets they prioritize when hiring, the challenges associated with finding qualified candidates, and their views on the effectiveness of current academic training programs.

Implications of the Response Distribution

The distribution of responses highlights the significant engagement of academic stakeholders in this study, reflecting their central role in developing the future EV workforce. However, input from industry participants provides a critical, much-needed balance, ensuring that the survey captures the perspectives of employers

who ultimately determine workforce demand. This balanced approach allows for a more nuanced understanding of the alignment (or lack thereof) between academic programs and industry needs, serving as the foundation for further analysis and recommendations. Admittedly, the academic-heavy response rate is likely a reflection of the nature of the participant network of the NEVC, but industry participation was highly emphasized.

Despite the overall response rate being modest, the breadth and diversity of respondents across sectors contribute to the robustness of the findings. The results will be further supplemented by follow-up interviews and additional qualitative research to ensure comprehensive coverage of key topics. This mixed-methods approach is designed to provide a holistic view of the current state of EV workforce development and inform NEVC's ongoing efforts to create standardized and accessible training pathways.

Results and Discussion

This section presents the findings from the two parallel surveys, one for academic respondents and one for industry respondents, were administered to gather complementary perspectives targeting both academic and industry participants. The survey was designed to identify areas of alignment and divergence in the perception of EV technician training and certification needs. Responses were gathered from academic institutions offering EV-related programs and industry stakeholders involved in hiring or interacting with EV technicians. The results provide insights into key areas such as hiring practices, field-specific placement or work involvement, desired certifications, and perceived gaps in existing certifications. The combined findings highlight both shared priorities and areas where further collaboration may be necessary to bridge the gap between academic preparation and industry expectations.

The first question asked of both academic and industry participants was designed to determine whether respondents have direct involvement with the EV workforce. Specifically, academics were asked: "Do you train, educate, or manage an academic program that places graduates in the EV industry?", while industry representatives were asked: "Do you hire EV technicians?" All participants were required to answer this question.

Table 2. Survey question #1 Responses – querying active participation in industry

Participant Group	Survey Question	Yes (%)	No (%)	Sample Size (n)
Academic	Do you train, educate, or manage an academic program that places graduates in the EV industry?	70%	30%	94
Industry	Do you hire EV technicians?	75%	25%	32

Academic Survey Results

- 70% of academic respondents indicated that they train, educate, or manage programs placing graduates in the EV industry, while 30% reported no involvement.

- A total of 94 academic representatives responded to this question, reflecting a broad sample of institutions ranging from community colleges to universities.

Industry Survey Results

- 75% of industry participants reported hiring EV technicians, while 25% indicated they do not.
- A total of 32 industry representatives responded, including employers from EV manufacturing, fleet operations, energy infrastructure, and other electrification-related sectors.

Comparison and Trends

- Both surveys reveal a strong majority involvement in EV technician placement or hiring: 70% on the academic side and 75% on the industry side.
- This 5% difference (75% vs. 70%) suggests that while there is close alignment, there remains a segment of the industry (25%) not currently hiring EV technicians. Possible reasons include differing business focuses, evolving market demands, or a narrower definition of "EV technician" (e.g., focusing only on certain types of EV repair or manufacturing roles).
- The presence of 30% of academic programs that do not yet place graduates in the EV industry also highlights a need for continued curriculum development and outreach. This gap underscores the importance of further collaboration and alignment to ensure that graduates' skill sets match industry hiring needs.

In summary, these results indicate that although most academic programs and industry employers are directly engaged in EV workforce development, there is room for growth in both areas. In particular, educators and employers can benefit from targeted partnerships that address the specific skills and credentials required in this rapidly evolving sector.

Question 2, aimed to identify which specific fields are addressed by academic programs and in which fields industry participants operate. Academic respondents were asked: "Which fields does your program place graduates? (Please choose all that apply)", Industry respondents were asked: "In which fields does your organization work? (Please choose all that apply)"

The table below compares the percentage of academic programs placing graduates in each field to the percentage of industry respondents working in those same fields. Respondents could select multiple options, and those who selected "Other" were able to write in additional fields.

Table 3. Survey Question #2 Responses – relative field of survey respondent

Field	Academic (%)	Industry (%)
Energy production	15%	27%
Energy infrastructure	14%	46%
EV manufacturing (includes automotive, aviation, marine)	32%	15%
Maintenance and repair (includes automotive, aviation, marine)	72%	23%
Energy storage (batteries)	20%	35%
Charging station installation, maintenance, etc.	15%	46%
Mobility	10%	31%
Fleet conversion	7%	42%

Field	Academic (%)	Industry (%)
Electrification	15%	46%
Other	6%	15%

Academic "Other" Write-Ins: "Mechatronics", "EV design"

Industry "Other" Write-Ins: "New car dealership", "Technical training", "Charging station", "Manufacturing", "Software support"

Academic Survey Results

- The top field for academic programs is maintenance and repair, with 72% of academic respondents indicating they place graduates in that area.
- EV manufacturing (32%) and Energy storage (20%) also have a notable share of program placements.
- A smaller but still relevant portion of programs (15% each) place graduates in Energy production, Charging station installation/maintenance, and general Electrification roles.
- "Other" fields (6%) included specialized topics such as mechatronics and EV design.

Industry Survey Results

- Energy infrastructure, Charging station installation/maintenance, and Electrification each garnered 46%, the highest percentage among industry respondents.
- Fleet conversion (42%), Energy storage (35%), and Mobility (31%) also represent key areas of industry activity.
- Maintenance and repair (23%) ranks somewhat lower among industry fields, in contrast to academia's stronger emphasis.
- The "Other" category (15%) included New car dealership, technical training, Charging Station Manufacturing, and Software support, illustrating a wide range of specialized niches in the EV ecosystem.

Comparison and Trends

- Maintenance and repair shows the biggest difference: 72% of academic programs place graduates in this field, but only 23% of industry respondents report operating in it. This suggests that while many schools focus heavily on repair pathways, fewer survey respondents on the industry side self-identify with that field, possibly due to narrower definitions or different hiring needs.
- Conversely, Energy infrastructure, Charging station installation/maintenance, and Electrification are prominent among industry respondents (all at or near 46%), but have lower placement percentages on the academic side (14—15%). This gap may indicate opportunities for academic programs to expand curricula or partnerships to better serve these growing segments.
- The differences in EV manufacturing (32% academic vs. 15% industry) and Fleet conversion (7% academic vs. 42% industry) also underscore the evolving nature of the EV workforce. These fields may warrant deeper exploration to ensure training aligns more closely with real-world needs.

Overall, these findings highlight both areas of strong academic focus, particularly maintenance and repair, and areas where academic and industry alignment could be improved, such as fleet conversion, infrastructure, and electrification. They also reveal a diverse and rapidly changing ecosystem in which specialized roles are emerging (e.g., mechatronics, charging station manufacturing), underscoring the importance of flexibility and ongoing collaboration between educators and employers.

Question 3 examined the certifications academic institutions currently embed in their programs versus the certifications industry employers value in new graduates. Academic respondents were asked: "What certifications are embedded in your academic program? (Please choose all that apply)", Industry respondents were asked: "What certifications are you looking for in a college graduate? (Please choose all that apply)"

The table below compares the percentage of academic programs embedding each certification to the percentage of industry respondents seeking that same certification in new hires. Note that participants could select multiple options, and those who chose "Other" could write in additional responses.

Table 4. Survey Question #3 Responses – querying known EV certifications

Certification	Academic (%)	Industry (%)
SAE ITC Probitas-NEVTEX EV Technician Certified Technicians	12%	16%
SAE International Electric Vehicle Supply Equipment (EVSE) technician certification	5%	26%
SAE & InnoEnergy Battery Academy	2%	11%
SAE High Voltage Vehicle Safety Systems	14%	42%
SAE High Voltage Safety and PPE	16%	47%
SAE Lithium Ion Family Battery Systems	9%	26%
SAE International Sustainable Mobility Solutions - Battery and Electrification Workforce	2%	26%
ASE Resources: xEV Safety certifications (Levels 1 & 2)	33%	21%
Weber State EV training: Phase I High Voltage Safety Training (online)	9%	11%
Weber State EV training: Phase II Hybrid and Electric Vehicle Systems (online)	7%	5%
Weber State EV training: Phase III Hybrid & Electric Vehicle Boot Camp (in-person)	7%	5%
National Fire Protection Association (NFPA 70E)	19%	26%
NFPA Energy Storage and Solar Systems Safety online training	3%	11%
NFPA EV fleet, dealership, utility, vehicle technician, tow/salvage, charging station, or community prep series	2%	21%
NFPA alternative fuel vehicles training for emergency responders	10%	16%
NEC & NFPA Certified Electrical Safety Worker exam/certification	2%	16%
NFPA Certified Electrical Safety Technician	3%	5%
Tesla Start	10%	11%
Tesla Internships	9%	26%
Tesla independent service & repair training programs	0%	16%
Tesla technician training schools	0%	5%
Hudson Valley Community College - Electric and autonomous vehicles	3%	5%
Other	38%	32%

Academic Survey Results

The most frequently embedded certification is ASE xEV Safety (Levels 1 & 2) at 33%, followed by SAE High Voltage Safety and PPE (16%) and NFPA 70E (19%).

A substantial 38% of academic respondents selected "Other," indicating a wide variety of local or specialized certifications. Some examples include:

- ASE L3, EV Pro+ (Levels 1–4), EVITP
- NC3 Snap-on insulation meters (planned)
- Ford ACE, Toyota TECS, MACS 609
- OSHA 10 – Automotive, Institute of the Motor Industry
- Multiple OEM vehicle literature
- No certifications yet or "due to costs, none as of now"

Industry Survey Results

- The top certifications sought by industry are SAE High Voltage Safety and PPE (47%), SAE High Voltage Vehicle Safety Systems (42%), and Tesla Internships (26%). Several other SAE-related and NFPA certifications also rank between 21% and 26%.
- Similar to academia, a significant 32% of industry respondents chose "Other," with write-in examples such as:

  "We do not require any specific certifications."

  "They are nice to have but not required."

  EVPRO+ Program, EVITP, Shoreline CC

  "Software support" and other specialized training

Comparison and Trends

1. SAE vs. ASE Emphasis:
   - Industry shows a stronger preference for SAE certifications (especially High Voltage Safety/PPE at 47%) than do academic programs (16%). Conversely, ASE xEV Safety ranks higher among academic programs (33%) than industry (21%).
2. Tesla-Related Training:
   - Tesla Internships have higher demand on the industry side (26%) than on the academic side (9%), suggesting that while some schools incorporate Tesla partnerships, there is still room for growth in Tesla-specific pipelines.
   - Tesla's independent service/repair programs are notably absent (0%) from academic offerings, but 16% of industry respondents say they look for them.
3. NFPA and NEC Certifications:
   - Industry respondents (21–26%) generally place more value on NFPA and NEC-related safety and electrical certifications than do academics (2–19%). This gap suggests a possible need for expanded coverage of electrical safety standards in academic curricula.
4. High "Other" Category:
   - Both academia (38%) and industry (32%) reported a wide range of additional or emerging certifications. This indicates a still-evolving certification landscape where local/regional programs, OEM-specific courses, and alternative credentials may play a significant role.

Overall, the data points to an ongoing need for closer collaboration between academic institutions and industry to align certification priorities, particularly in areas like high-voltage safety, Tesla-specific training, and NFPA/NEC electrical safety standards. The high percentage of "Other" responses further underscores that the EV certification ecosystem is still in flux, with many institutions and employers experimenting or using specialized credentials to meet evolving technical demands.

Question 4 asked the same question of both academic and industry participants in order to gain insight into the challenges surrounding EV training, as seen by both groups. Question 4 asked, "Where are the gaps in EV industry certifications?". The response collected was fill-in only. Responses were coded for key thematic information and are identified below.

Academic respondents provided a wide range of comments reflecting the complexity of designing EV-related programs. Common themes include:

1. Access and Funding
    - "Charging stations repair and troubleshooting … limited access to training components."
    - "Funding of facilities capable of building and sustaining an EV program … lack of EV vehicles to use for training."
    - "Due to costs, none [of these certifications] as of now."
2. Lack of Standardization
    - "Limited offerings; there should be a standard, having one recognized [certification]."
    - "Professionals in the industry have not settled on a preferred certifying body."
    - "Overbearing external certification bodies … trying to embed their certification."
3. Early-Stage Program Development
    - "Do not know yet; but that is what we are finding out."
    - "Too early for us to know; we are just writing [the] program now."
    - "We are beginning a new program … establishing certifications."
4. Specific Technical Gaps
    - "Cybersecurity, controls, software platforms … [and] networking qualifications."
    - "More options for EVSE technicians—installations as well as operations/maintenance."
    - "EV charging *equipment maintenance, EV site design and verification."*
5. OEM Involvement
    - "OEMs don't want 'entry-level' EV techs … [they want] specialized."
    - "Lack of support for EV training available from the manufacturers."
    - "ASE xEV ... not recognized by OEMs."
6. Cost and Complexity
    - *"* Cost, some of the SAE training cost more than $3K per class."
    - "EV Pro Plus is quite complex."
    - "ASE = cost and pre-reqs prevent student testing*."*

Overall, the academic responses highlight financial barriers, confusion around which certifications to adopt, and limited OEM engagement. Many programs are just starting to implement EV-related curricula, and instructors often feel they lack resources or a clear roadmap to guide their efforts.

Industry participants also identified several major gaps in EV certifications, though their focus often centered on awareness, standardization, and practical applicability:

1. Limited Awareness of Certifications
    - "I only know of the certifications that Tesla provides."
    - "Not enough knowledge of certifications, how they compare … why one is better."
    - "As a hiring manager, how do I keep up while getting my day job done?"
2. Need for Standardization and Clarity
    - "There are a lack of standards overall for each individual aspect dealing with building and repair."
    - "Too many entities trying to re-invent the wheel."
    - "There is extreme difficulty determining if an 'expert' is real … if a 'qualified' individual is truly qualified."
3. Greater Accessibility and Program Availability
    - "More program offerings at the Association, Technical, Community college level … accessible and affordable."
    - "There are not enough training programs and scholarships."
4. Practical Skill Emphasis
    - "Increased training in basic service procedures."
    - "Job mapping needed so certifications apply to different facets of the EV ecosystem."
    - "We have been teaching aspects of EV infrastructure since inception."

Industry's overarching concern is that the current EV certification landscape is fragmented and confusing, making it difficult to know which credentials truly demonstrate a candidate's competence. Participants also emphasized the importance of expanding the availability of high-quality, affordable programs that provide practical, job-relevant skills.

Comparison and Synthesis

Common Themes:

- Both academic and industry respondents point to limited standardization, insufficient awareness of existing certifications, and lack of resources/funding as major hurdles. Accessibility, whether it be cost, geographic location, or time constraints, was also a frequent concern.

Differences:

- Academics often cite early-stage curriculum development, lack of OEM support, and high-cost certification fees as key obstacles.
- Industry participants are more likely to stress the need for clarity on which certifications matter, along with practical job mapping so that each certification aligns with a specific role or skill set in the EV ecosystem.

Implications for Collaboration

1. Developing a Clear, Recognized Standard

The most pressing issue identified by both groups is the absence of widely accepted EV certification standards. Establishing a single recognized body or set of criteria could reduce confusion and create consistent expectations for graduates.

2. Enhancing Awareness and Accessibility

A central repository or clearinghouse for EV certifications could help both educators and employers understand which credentials align with specific roles (e.g., EVSE technician vs. high-voltage repair). Increasing scholarships or funding to lower the cost barrier is also crucial.

3. Involving OEMs and Industry Leaders

Deeper collaboration with manufacturers and industry experts could ensure that academic programs incorporate the latest technology and standards, while also clarifying how certain certifications translate to real-world competence.

4. Expanding Technical Scope

Topics like cybersecurity, software integration, and advanced controls are increasingly important in EV roles, yet many existing certifications focus on mechanical or electrical fundamentals. Both academia and industry highlight the need to broaden the scope of training.

The open-ended responses for Question 4 reinforce the idea that EV workforce development requires cohesive, collaborative strategies. By addressing cost barriers, clarifying certification relevance, and fostering tighter partnerships among OEMs, educators, and industry organizations, stakeholders can better equip new technicians to meet the fast-evolving demands of the electrification sector.

Limitations

It should also be noted that while the industry responses provide valuable insights, the relatively small sample size (n=32) limits the ability to generalize findings to the broader EV industry. These results should be interpreted as indicative trends that warrant further investigation with larger samples. Additionally, although an overall response rate is presented, it is intended solely as a measure of total participation rather than a combined statistical measure of survey reliability.

Conclusion

The survey results highlight critical gaps and points of alignment between academic training programs and the evolving needs of the electric vehicle (EV) industry. These findings demonstrate the complex, multidisciplinary nature of workforce development in the electrification sector and emphasize the need for ongoing collaboration between academia and industry to address misalignments, expand training accessibility, and develop coherent certification pathways.

Overall, the data show that both academic institutions and industry employers are actively engaged in electrification-related activities; however, the exact nature of that engagement and the specific areas of focus vary considerably, leading to several points of misalignment.

Alignment and Engagement

Both groups reported a high level of direct involvement in the EV workforce. According to Question 1, 70% of academic respondents place graduates in EV-related roles, and 75% of industry respondents currently hire EV technicians. This close but not identical alignment suggests that while a majority of institutions and employers are invested in electrification, there remains a notable portion (30% of academics and 25% of industry) that either has not yet integrated EV-specific curricula or does not hire EV technicians. This gap underscores an opportunity to expand outreach and to support those not currently engaged in electrification, potentially by providing clearer roadmaps or demonstrating the tangible benefits of entering the EV space.

Fields of Focus

The data from Question 2 highlight a substantial difference in where academic programs place graduates versus the fields in which industry participants operate. Maintenance and repair stands out as the top field for academic programs (72%), yet only 23% of industry respondents self-identify as working in that area. In contrast, energy infrastructure, charging station installation, and electrification each see higher involvement on the industry side (all around or above 40%), compared to around 15% on the academic side. These mismatches likely reflect the historical emphasis on traditional automotive repair training within colleges, while newer or fast-expanding fields, like fleet conversion and advanced infrastructure, have not yet been fully incorporated into academic curricula. The substantial differences in these fields point to a need for ongoing program development and stronger industry-academia communication to ensure training aligns with current job market realities.

Certification Gaps and Priorities

Question 3 delves into the specific certifications embedded in academic programs and those most valued by employers. ASE xEV Safety (Levels 1 & 2) remains the most common certification in academic curricula (33%), whereas SAE High Voltage Safety and PPE and SAE High Voltage Vehicle Safety Systems rank as top industry preferences (47% and 42%, respectively). The relatively higher industry demand for SAE credentials, especially those addressing high-voltage safety, suggests a need for colleges to consider expanding their focus on these areas, given that employers perceive them as crucial for technician preparedness. Additionally, Tesla-specific training (e.g., Tesla Internships) shows a notable gap: 26% of industry respondents look for it, compared to only 9% of academic programs embedding it. These disparities highlight the importance of close partnerships with OEMs and third-party certification providers, so academic institutions can stay abreast of the rapidly evolving technical demands of electrification.

Persistent Barriers and Thematic Insights

Open-ended responses in Question 4 reveal a common set of challenges for both academics and employers. Access and funding remain central concerns, with limited resources to develop EV-specific labs, purchase vehicles for hands-on training, or subsidize certification costs for students. Many academic respondents also report being in the early stages of program development, leading to uncertainty about which certifications to embed. Meanwhile, industry participants voice frustration over the lack of a unified standard and difficulty evaluating a growing number of credentials, often developed in parallel by different organizations. The data further underscore the need for broader coverage of emerging skills, such as cybersecurity, EVSE installation, and advanced controls, that go beyond traditional mechanical or electrical competencies.

OEM Collaboration and Real-World Alignment

A recurring theme across questions is the importance of OEM engagement. Academic respondents note that OEM support can be difficult to obtain, especially for “entry-level” technicians, while industry feedback emphasizes the confusion around how (or whether) certain certifications align with manufacturer standards. Strengthening ties between colleges and OEMs could address this gap, ensuring that training programs reflect genuine, real-world requirements. This collaboration would help standardize the skill sets expected of new technicians, improve OEM acceptance of recognized credentials, and offer students more direct pathways into EV-focused careers.

Moving Toward Standardization and Accessibility

Taken together, these findings highlight a rapidly evolving EV ecosystem in which safety, infrastructure, and advanced diagnostics have emerged as key priorities. Although academics and industry respondents share the overarching goal of producing well-prepared EV technicians, the fragmented certification landscape complicates that mission. Moving forward, a multi-pronged strategy is needed—one that addresses resource limitations, expands coverage of in-demand fields like fleet conversion and charging infrastructure, and

unifies various credentialing efforts under a more coherent framework. Such efforts may include developing consistent national standards, increasing funding availability, and strengthening regional consortia that bring together employers, OEMs, and educational institutions to align on curriculum updates and resource sharing.

The survey data provide a clearer picture of where academia and industry align (high-voltage safety, overall growth in electrification) and where they diverge (maintenance vs. infrastructure emphasis, preferred certification bodies). By focusing on collaborative program design, deeper OEM partnerships, and more transparent pathways to recognized credentials, stakeholders can better ensure that graduates are equipped to meet the technical and safety demands of an expanding EV market.

Recommendations

Two groups, the CREATE Energy Center and Clemson's Automotive Cluster, have acknowledged these disparities, gaps, and opportunities in their work with NABCEP and SAE. By engaging industry and academia from the outset, these groups have developed new industry certifications that align with both academic capabilities and industry needs. This collaborative model, proven successful in renewable energy and energy storage contexts, is worth replicating across the broader EV sector.

Lessons / Case Study from the Solar and Energy Storage Industry

The challenges faced by the EV sector mirror those encountered during the early stages of the solar industry, where fragmented training and certification pathways initially hindered workforce development. Over time, organizations like the North American Board of Certified Energy Practitioners (NABCEP) helped establish standardized training and certification systems that facilitated industry growth. NEVC can draw on these lessons by promoting collaboration between established businesses, startups, and training institutions, ensuring that the EV industry evolves with a coherent and sustainable approach to workforce development.

As in the EV sector, there are a multitude of certifications in the areas of solar photovoltaics and energy storage. Many of these are vendor-specific and are obtained by completing specified OEM training. However, manufacturers have varying standards, and these certifications can require anywhere from 1-40 hours to complete. Some OEMs offer training in person, but more common is some type of online video delivery. Usually, an assessment of some type is required for the individual to demonstrate proficiency, but the rigor required differs dramatically.

This disparate playing field created the opportunity for 3rd party certification bodies to produce a common set of standards for the solar and energy storage industry that would be vendor agnostic. There are a handful of 3rd party certification organizations in the solar and energy storage realm, with NABCEP, Electronics Technicians Association (ETA), and Association of Energy Engineers (AEE) representing the bulk of the market share.

A respected approach to the development of an industry certification is to begin by conducting a Job Task Analysis. Typically, a committee of experts is convened that first defines the occupation (e.g., solar photovoltaic (PV) installer), and then breaks the job down into a series of tasks. Tasks may include both the application of functional knowledge and the demonstration of practical skills required by the individual. Often, the tasks may be grouped into subcategories or domains based on various sub-disciplines within the occupation (for example, solar design, vs installation, vs maintenance).

The job tasks are then ranked by their relative importance and the frequency with which they are encountered on the job. Priorities are sometimes weighted, based on the critical nature of specific tasks, accounting for the adverse consequences if an individual is not knowledgeable/competent for that particular job function.

Ranking of job tasks should capture the input from individuals outside of the expert committee. Survey tools deployed using the internet allow for sampling many people working in the field. Statistical analysis can be employed to examine the variance of survey respondents and to ascertain if there is aggregate agreement on individual task items. For items that demonstrate disparity of opinions, it may be necessary to survey a larger group of people, or tasks may need to be reviewed and rewritten to be more specific and better reflect a common point of view.

Once the Job Task Analysis has been finalized and validated by industry representatives, an examination committee can then begin the process of developing the assessment tools that will be used to measure the competency of individuals seeking the certification. This may take the form of a written examination of content knowledge, a practical examination of hands-on skills, a demonstration of work experience, or some combination thereof.

For the solar photovoltaic industry, NABCEP has become one of the more commonly recognized industry certifications. Many community and technical colleges have accordingly aligned their curriculum to address the standards that are covered by the NABCEP solar PV job task analyses. Several schools have become NABCEP-registered training providers, and some of these also serve as test centers administering NABCEP examinations to individuals seeking certification. The key benefit to students is that since the NABCEP certifications serve as indicators of professional competency, many employers screen for these credentials when hiring new employees. Furthermore, the NABCEP PV Associate and PV installation Professional certifications are generally accepted across state lines. So, for graduates that might relocate outside of a given district, this certification helps to validate the learning that the student completed while enrolled at the institution of higher education.

Acknowledgements. This work was supported by the National Science Foundation under award #2202050.

Disclosures. The authors declare no conflicts of interest.

References

[1] International Energy Agency, *Global EV Outlook 2023*, IEA, Paris, France, 2023. [Online]. Available: https://www.iea.org/reports/global-ev-outlook-2023

[2] National Renewable Energy Laboratory, *EV Workforce Challenges and Opportunities*, NREL, Golden, CO, 2022. [Online]. Available: https://www.nrel.gov

[3] U.S. Department of Energy, *Energy Workforce Needs Report*, U.S. DOE, Washington, DC, 2023. [Online]. Available: https://www.energy.gov

[4] J. Burns and M. Jones, "Workforce development in a rapidly electrifying world," *J. Energy Educ.*, vol. 5, no. 2, pp. 45–58, 2021.

[5] Energy Futures Initiative, *The U.S. Energy and Employment Report 2022*, EFI, Washington, DC, 2022. [Online]. Available: https://www.energyfuturesinitiative.org

[6] K. Takahashi, R. Smith, and A. Patel, "Bridging educational silos for energy innovation," *Energy Policy J.*, vol. 154, pp. 112–120, 2022.

[7] Brookings Institution, *Preparing the U.S. Workforce for the Electric Vehicle Transition*, Washington, DC, 2021. [Online]. Available: https://www.brookings.edu

[8] Center for Renewable Energy Advanced Technological Education (CREATE), *Annual Report 2022*, Madison Area Technical College, Madison, WI, 2022. [Online]. Available: https://createenergy.org

[9] Center for Renewable Energy Advanced Technological Education (CREATE), *International Energy Education: Lessons from the Field*, Madison Area Technical College, Madison, WI, 2021. [Online]. Available: https://createenergy.org/resources

[10] Clemson University Center for Workforce Development, *NSF ATE Project Summary: Developing Cross-Disciplinary EV Technician Training*, Clemson, SC, 2023. [Online]. Available: https://www.clemson.edu/cecas/workforce-development

[11] EducateWorkforce, *Immersive Learning Modules for Electric Vehicle Technician Education*, Clemson University, Clemson, SC, 2023. [Online]. Available: https://educateworkforce.com

[12] Weber State University, *Automotive Technology – EV and Hybrid Systems Training*, Ogden, UT, 2023. [Online]. Available: https://www.weber.edu/automotive

[13] National Fire Protection Association, *NFPA Electric Vehicle Safety Training for Emergency Responders*, Quincy, MA, 2023. [Online]. Available: https://www.nfpa.org/ev

[14] Shoreline Community College, *Clean Energy Technology Program: EV Technician Pathway*, Shoreline, WA, 2023. [Online]. Available: https://www.shoreline.edu

[15] National Electric Vehicle Consortium (NEVC), *Building the National EV Workforce: Best Practices and Models*, NEVC, 2023. [Online]. Available: https://www.evworkforce.org