Developing Career-Ready Engineers for the Power & Energy Field: the [Energy Center Name] Scholars Program

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Work-in-Progress: Developing Career-Ready Engineers for the Power & Energy Field: the EPIC Scholars Program

Abstract

To meet the evolving demands of the power and energy sector, the UNC Charlotte Energy Production and Infrastructure Center (EPIC) Scholars Program provides sophomore and junior engineering students with a targeted professional development framework. Designed in collaboration with industry partners, the program bridges the gap between foundational technical expertise and essential professional competencies.

The initiative is structured around three core pillars: 1. A Professional Development Series: six monthly modules focused on project management, networking, and high-stakes communication; 2. Career-Building Sessions: Industry-led panels on topics like grid modernization and utility asset management to provide real-world context, and 3. Mentorship: Direct engagement with industry professionals.

By intervening early in the academic career, the program enables students to apply leadership and interdisciplinary teamwork skills to their coursework and internships. Program effectiveness will be measured through pre- and post-program self-assessments alongside quantitative metrics such as internship placement rates and academic performance. This work-in-progress paper outlines the program's design and preliminary outcomes, offering a scalable model for aligning undergraduate engineering education with the strategic talent needs of the energy workforce.

I. Introduction and Motivation

The global power and energy landscape is undergoing a fundamental paradigm shift, transitioning from a centralized, fossil-fuel-dependent infrastructure to a decentralized, decarbonized, and digitized grid. This evolution - driven by the urgent need for grid modernization, increase in demand with data centers and other large loads, renewable energy integration, and the rise of the "prosumer" - has fundamentally altered the expectations for the next generation of power and energy professionals [1]. As the world moves toward a carbon-neutral future, the industry requires more than just technical proficiency; it requires a workforce capable of navigating complex, socio-technical systems.

Despite the increasing demand for power and energy engineers, the sector faces a significant workforce challenge. The U.S. Department of Energy has identified a critical need for skilled workers to support the energy transition, noting that a substantial portion of the current utility workforce is approaching retirement [2]. This creates a "knowledge drain" at the same moment that grid complexity is peaking. Furthermore, traditional engineering curricula often lag behind industry trends, frequently focusing on steady-state analysis while the industry moves toward dynamic, power electronics, and real-time data analytics [3, 4].

This skill gap represents a critical bottleneck. To meet the demands of the modern power and energy field, engineers must now possess a broad, interdisciplinary perspective that spans:

electrical engineering: power systems, microgrids, and power electronics, computer science: cybersecurity, data science, and IoT integration, and civil & mechanical engineering: structural integrity of assets and thermal management of storage systems, among many others.
Technical excellence alone is no longer sufficient for career readiness. The modern power engineer must balance deep technical knowledge with a suite of professional competencies ("soft skills"). Research indicates that while engineering graduates are technically sound, they often lack the professional competencies required to navigate corporate and regulatory environments [5]. Specific skills required for success include:

- High-Stakes Communication: Translating technical data for stakeholders, policy makers, and community members;
- Interdisciplinary Collaboration: Bridging the gap between diverse engineering disciplines and non-technical departments (legal, environmental, financial); and
- Complex Problem-Solving.

To address these evolving needs, the UNC Charlotte Energy Production and Infrastructure Center (EPIC) Scholars Program was developed as a targeted, academic-year professional development initiative. Unlike traditional senior capstone projects, this program focuses on early intervention, specifically targeting sophomore and junior engineering students. Partial support of the program comes from the EPIC Affiliates Program, an industry membership program that focuses on workforce development.
The statement of purpose for the Scholars Program is twofold: to equip students with specialized industry knowledge not typically covered in the general curriculum and to cultivate advanced professional competencies before they enter the workforce. By engaging students during their sophomore and junior years, the program maximizes its impact on their core coursework and informs their early career decisions, such as high-impact internships and career placements [6].

This paper is organized as follows:

- *Section II: Literature Review and Theoretical Framework* - examines current workforce demands and the critical role of professional competencies in engineering success, establishing the theoretical foundation of the proposed program.
- *Section III: Program Design and Industry Collaboration* - details the specific modules, industry partnerships, and pedagogical strategies used to deliver both technical and professional content.
- *Section IV: Implementation and Logistics* - describes the student selection process and the logistical framework of the program, including a short description of the first cohort which is currently going through the program.
- *Section V: Program Evaluation Methodology* - provides the plans in place to analyze program effectiveness and success, including pre- and post- surveys, internship placement rates, and qualitative feedback from industry mentors.
- *Section VI: Program Replicability and Generalizability* - outlines how the program's modular structure and professional development tools allow framework adaptation and scalability.
- *Section VII: Preliminary Discussion, Conclusion and Future Plans* - summarizes the proposed program and its expected contributions, reflects on the challenges encountered with the first cohort, and discusses future plans.

II. Literature Review and Theoretical Framework

The global energy transition has fundamentally altered the professional landscape for engineers. As the grid moves toward a decentralized and digitalized architecture, the National Academy of Engineering (NAE) "Grand Challenges" highlight the urgent need to improve urban infrastructure through smarter, more resilient energy systems. However, a significant "skills gap" persists between academic preparation and industry requirements. Recent studies indicate that up to 40% of global power executives cite an insufficiently skilled workforce as their primary challenge in filling engineering roles [7]. This gap is exacerbated by a retiring utility workforce and a traditional curriculum that often does not cover the dynamic, real-time data analytics required for modern grid management.

To meet ABET Criterion 3 requirements, programs must go beyond technical knowledge to ensure students can "recognize ethical and professional responsibilities" and "function effectively on a team" [8]. In the power sector specifically, there is a rising demand for professionals who possess deep technical expertise alongside a broad understanding of the economic, regulatory, and social contexts of energy [7, 9]. While technical proficiency is the price of entry, professional competencies - often called "soft skills" - are the primary predictors of long-term career success and leadership potential. Engineers with strong interpersonal skills can increase their productivity, yet many entry-level engineers fail to meet employer expectations in areas like interdisciplinary collaboration and communication [10]. In North Carolina, this need is formalized through the *Portrait of a Graduate* framework. This statewide initiative identifies seven "durable skills" essential for the 21st-century workforce: adaptability, collaboration, communication, critical thinking, empathy, learner's mindset, and personal responsibility [11]. For the power industry, these skills are not merely nice to have, they are critical for engineers who must translate complex technical topics to regulatory bodies, lead diverse project teams, and adapt to rapidly evolving policies.

Traditional curriculum addressing professional development often culminates in a senior-year capstone project. However, research suggests that the second and third years of undergraduate study are the "sweet spot" for career intervention [12]. Early-stage exposure during the sophomore and junior years provides several strategic advantages: academic relevancy - students gain a clearer sense of purpose, which increases motivation and retention in rigorous core engineering courses [13]; internship readiness - professional development prior to the junior year allows students to secure and excel in internships, which are often the primary pipeline for full-time employment; professional formation and mindset: early intervention helps students transition from a student mindset to a professional mindset before they enter their final year of their degree [14]. The EPIC Scholars Program expands upon traditional models by moving professional development earlier on in the program and exposing students to professional interactions and industry members.

III. Program Design and Industry Collaboration

The program was conceptualized as a bridge between academic engineering curricula and the expectations of the current and future energy workforce. By integrating professional

development with industry-specific context, the initiative seeks to produce “work-ready” graduates capable of navigating complex technical and interpersonal landscapes.

The primary target audience comprises sophomore and junior undergraduate students from all engineering disciplines. This intentional recruitment strategy ensures interdisciplinary diversity, mirroring the cross-functional teams prevalent in the energy sector. Eligible participants must either have an energy concentration or demonstrate a stated interest in the field. The program’s overarching objectives are three-fold:

- Enhance professional competencies (soft skills),
- Cultivate a deep understanding of the energy sector, and
- Improve career placement success through direct industry exposure.

Furthermore, the program is intentionally aligned with the North Carolina Portrait of a Graduate, emphasizing durable skills such as adaptability, collaboration, and critical thinking.

Collaborative design and delivery with industry partners

A fundamental aspect of the program is its collaborative development with industry members. In early 2025, a needs assessment was conducted through dialogue with industry partners and the [Energy Center] External Advisory Board. These conversations revealed a critical gap: while graduates are technically proficient, they often lack the “soft skills” that serve as a primary differentiator in hiring and in career/workplace success. Industry leaders highlighted effective communication and time management as urgent priorities. The Advisory Board underscored that a dedicated professional development initiative would not only enhance the student experience but also significantly differentiate the university’s engineering graduates in the job market.

Industry involvement extends beyond ideation and program design into ongoing delivery. Approximately 30 professionals engage with the program annually, serving as mentors, panelists, and activity facilitators. This sustained interaction provides students with an expansive professional network and real-world perspectives.

The Scholars Program is structured around three main components: 1. the Professional Development Series, 2. the Career-Building Sessions, and 3. the Mentorship Program.

Main Component 1: The Professional Development Series

The Professional Development Series consists of six monthly modules designed to cultivate essential soft skills through facilitated, interactive workshops. Each module requires students to engage in pre- or post-session tasks, utilizing a methodology of guided reflection and peer-to-peer critique.

- *Professionalism and Work Ethics*: Focused on accountability and career readiness. Students analyze their VIA Character Strengths [15, 16] results to understand how personal attributes impact workplace performance.
- *Foundations of Soft Skills*: Covers teamwork, emotional intelligence, and relationship management. A “Shape Activity” is utilized to help scholars identify and refine verbal and non-verbal communication cues.

- *Advanced Interview and Other Career Skills*: Students apply practical preparation strategies using the Big Interview platform, practicing responses to industry-specific behavioral questions.
- *Problem Solving and Critical Thinking*: Scholars observe videos of workplace challenges and engage in facilitated discussions to propose resolutions, focusing on tools to handle conflict and ambiguity.
- *Developing the Leader in You*: Students complete a Leadership Style Assessment to identify which of the five core leadership styles they resonate with, followed by a workshop on situational leadership.
- *Level-up Your Career Game*: This module focuses on the mechanics of networking within the regional ecosystem, teaching best practices for building meaningful professional connections.

Main Component 2: The Career-Building Sessions

While the professional development series focuses on the *individual*, the Career-Building sessions are panel sessions that focus on the *industry*. These sessions contextualize technical learning by exposing students to current challenges and specific career pathways.
These panel sessions address important industry areas of focus, including: Grid Modernization Technologies (Smart Grid, resiliency), Utility Asset Management and Risk, Emerging Energy Sources (e.g., Nuclear, Hydrogen), Policy and Regulatory Landscape. Specifically, the list of panels offered this academic year for the first cohort is included in the table below. It is noted that these sessions are open to all students, and not just those in the EPIC Scholars Program.

Table 1: Career-Building Session Themes and Panels

Industry Focus Area	Panel Discussion Topic
Grid Modernization	● Opportunities in Operating the Modern Power Grid ● Opportunities for Communications & Computer Engineering
Asset Management	● Opportunities in Utility Asset Management & Risk
Emerging Energy	● Opportunities in Nuclear Power
Manufacturing/Design	● Opportunities in Grid Tech Manufacturing ● Opportunities for Transmission Line Design & Construction
Career Entry	● The Benefits of a Career in Energy

The panel sessions feature alumni and industry veterans at various career stages. By discussing topics such as the policy and regulatory landscape and grid resiliency, the sessions provide the necessary context that traditional technical courses may lack. This value proposition ensures students see the big picture of the energy transition, making them more effective contributors from day one of their professional careers. Moreover, the career-building sessions are meant to expose students to the wide range of opportunities in the power and energy field.

Main Component 3: The Mentorship Program and Other Interactions with Industry Professionals

The third component of the Program is an industry mentorship that pairs students with experienced professionals from the EPIC Affiliates Program. These mentors, all practitioners within the electric power industry and related engineering sectors, represent a diverse range of technical backgrounds and leadership roles.

While for the inaugural cohort the mentorship launched in the Spring semester, all subsequent cycles the mentorship will span the full academic year, beginning in Fall 2026. Beyond the EPIC Scholars, the program is also open to students enrolled in the College of Engineering energy concentrations and those actively participating in qualifying industry events.

The mentorship program's core objectives are to:

1. Empower Students: pair students with mentors who serve as dedicated guides and professional champions,
2. Expand Industry Knowledge: deepen student understanding of the energy and power sectors, and
3. Bridge the Talent Gap: connect industry Affiliates with a pipeline of prospective interns and employees.

Scholars are invited and encouraged to participate in other events organized by EPIC that engage industry partners. The Lunch and Learn Recruiting Series offers students the opportunity to learn about different segments of the power sector and directly connect with EPIC Affiliates that offer internships and early career positions. The Scholars are also invited to the Center's External Advisory Board reception, an opportunity to meet and engage with board members who are executive/C-suite level professionals in the power industry.

IV. Implementation and Logistics

The program recruited a diverse cohort of energy-interested students through a multi-channel strategy involving physical signage (flyers), targeted emails, and presentations in energy-focused engineering courses. Faculty with relevant research interests further promoted the opportunity, highlighting a $500 scholarship available upon successful completion. This approach ensured outreach spanned all engineering departments to attract students with specific interests in the power sector.

Applicants provide their resume, a writing sample, and a one-minute video recording describing their motivation for participating in the program. The assessment and selection utilized a rubric comprising five distinct evaluation criteria: purpose and passion, leadership potential, engagement and collaboration, video introduction, and writing sample quality. The selected students scored high on interest in the energy and power industry, academic standing, came across as articulate, and projected a polished image.

Applications open at the end of the Spring term and close during the second week of the Fall term. Students are selected by the third week of the Fall term. A detailed schedule of the 6

monthly Professional Development modules and the career-building panels is shared during program promotion, on the website and printed promotional materials. Each session is an hour long and depending on the theme, it may require students to prepare prior to the session or complete post-session tasks. To transition students from a classroom setting to a professional environment, all sessions are hosted in a large corporate conference room.

The inaugural EPIC Scholars cohort comprises 16 high-achieving participants, representing a diverse cross-section of technical disciplines. The group's gender composition is 75% male and 25% female. The cohort is composed of students from the Electrical Engineering (6), Electromechanical Engineering Technology (5), Mechanical Engineering (4), and Construction Management (1) degree programs.

V. Program Evaluation Methodology

To rigorously assess the effectiveness of the program and its impact on student professional development, a mixed-methods evaluation framework will be employed. Quantitative data - collected via pre- and post- surveys and self-assessments - will provide a measurable baseline for skill acquisition. This will be complemented by qualitative insights gathered through student exit interviews and focus groups, which will allow us to capture the lived experience of the participants, identify specific barriers to soft-skill application, and refine the curriculum to better align with the realities of the engineering workplace. In doing so, we plan to validate the program's efficacy and identify specific areas for iterative improvement. It is noted that this paper is a Work-In-Progress paper as the first cohort of students is currently going through the program; hence, we do not yet have gathered a lot of data to analyze.

The qualitative component of the program evaluation approach we are envisioning focuses on the internal shifts in student identity, confidence, and professional self-efficacy. We will use self-assessment instruments - a series of pre- and post- surveys that will be administered to capture self-perceived changes. Central to this is the VIA Character Strengths assessment, which students will complete at the program's onset and conclusion to track developments in self-awareness and core virtues. We will also utilize self-efficacy mapping in Likert-scale form to ask student participants to measure perceived growth in specific competency domains, including networking confidence, the ability to navigate interdisciplinary team dynamics, and self-awareness regarding career goals. We also plan on performing exit interviews upon program completion, to identify the most impactful curriculum modules and gathering constructive feedback for future cohorts.

To demonstrate the program's value to stakeholders and its alignment with industry needs, we plan on tracking several objective performance indicators, which are summarized in Table 2 below. Moreover, beyond student outcomes, the program will evaluate its integration within the broader professional ecosystem. We intend to survey external stakeholders and hiring managers to assess their perceived readiness of program participants. In regards to program performance and health, we intend to track interest-to-enrollment ratios and the diversity of disciplines represented in the applicant pool. Granular data on session attendance, mentorship meeting frequency, and student response rates will be used as a proxy for program health and student engagement.

Table 2. Program's Performance Indicators

Category	Metric	Goal/Comparison
Career Trajectories	Internship/Co-op Placement	Track placement rates specifically within the energy sector
Market Success	Interviews & Offers	Track the number of interviews and job offers student participants receive upon graduation
Academic Performance	Core Course Grades	Compare GPA in energy-related technical courses against a non-participant control group
Retention	Graduation Rates	Ensure program participants meet or exceed graduation benchmarks

VI. Program Replicability and Generalizability

The EPIC Scholars Program is designed as a modular and scalable framework that can be adapted by other engineering colleges to address the universal gap between technical proficiency and professional readiness. By decoupling the core professional development modules from the industry-specific career panels, the program provides a flexible template that can be tailored to any engineering discipline facing similar workforce transitions.

To ensure successful implementation in other contexts, the following elements are emphasized for their replicability:

- Modular Skill Sets: The six monthly professional development modules - ranging from high-stakes communication to leadership - focus on durable skills that are valuable across all corporate and regulatory environments.
- Targeted Student Timing: The focus on sophomores and juniors is a strategic choice that remains effective regardless of the engineering field, as it intervenes during the critical developmental window when students are most receptive to professional formation before entering their final year.
- Industry-Agnostic Logistics: The use of corporate conference rooms to shift student mindsets and the incorporation of existing tools like the Big Interview platform or VIA Character Strengths assessment reduces the need for department-specific infrastructure.
- Standardized Evaluation: The mixed-methods approach of pre- and post-program surveys, along with tracking internship placement rates, offers a roadmap for any institution to measure program efficiency and student professional self-efficacy.
- Adaptable Incentive Structures: While the current model utilizes a $500 scholarship to encourage completion, the program remains viable for institutions with limited funding through alternative recognition methods, such as digital badges or formal transcript notations.
- Curriculum: The program's efficacy is not dependent on a closed curriculum, but rather on the intentional assembly of high-impact professional development topics. Leveraging standard university career offerings allows for a scalable model where the curriculum is tailored to the unique professional landscape of a given engineering field.

Industry integration can be specific to the targeted engineering sector:

- Contextual Industry Panels: Organizers can replicate the “Career-Building Sessions” by hosting industry-led panels that connect technical theory directly to real-world career pathways and emerging sector trends.
- Industry-Led Needs Assessment: Program organizers can ensure regional relevance by conducting a needs assessment with local industry partners to identify the specific professional gaps most critical to their region or targeted sector.
- Scalable Mentorship Framework: The mentorship component can be duplicated by pairing students with practitioners from relevant professional societies or affiliate programs, providing students with "professional champions" while creating a direct talent pipeline for industry partners.

VII. Preliminary Discussion, Conclusion and Future Plans

While this Work-in-Progress paper focuses primarily on the pedagogical framework and program design, the implementation phase will actively yield both qualitative and quantitative insights. To ensure the rigor of the assessment, the evaluation framework is grounded in established High-Impact Practices [17] and the NACE Career Readiness Competencies [18], which serve as proven benchmarks for workforce development.

Participation data indicates high levels of student commitment; scholars have maintained consistent attendance at sessions and demonstrated active engagement during career panel discussions. Preliminary results indicate that the program enhanced participants’ professional self-efficacy and skill acquisition. 80% of the participants perceived the *Advanced Interview* session to be the most useful, followed by *Level-Up Your Career Game: Networking Matters*. Evaluation of workforce readiness revealed that 93.3% of participants feel significantly more confident entering the professional workforce than they did at the program’s inception. Specifically, 73.4% felt prepared to excel in interviews, while 86.7% reported increased readiness to participate in networking events and expand their professional networks. 73.3% of participants indicated they successfully applied the curriculum’s problem-solving and critical thinking techniques to their daily lives. Furthermore, 60% of the cohort reported a clearer understanding of their personal leadership style. The program has also shown to produce tangible professional outcomes. As of April 27, 2026, 60% of the inaugural cohort has secured summer internships directly related to the program's focus areas.

The next phase of this research will focus on a thematic analysis of qualitative feedback from student focus groups and a quantitative analysis of pre- and post-assessment data. These metrics will specifically quantify gains in professional self-efficacy and professional identity beyond the initial survey findings of self-perceived improvements. The program’s performance indicators (Table 2) will be tracked. All gained insights will be used to iteratively refine the program for the next cohort of student participants in the 2026-2027 academic year.

The EPIC Scholars Program represents an integrated approach to engineering education, treating technical context and professional “soft” skills as inseparable components rather than parallel tracks. By aligning undergraduate training with critical industry needs in the power and energy sector, this program provides a model for modernizing workforce development. The curriculum

and industry-engagement structures have been designed for generalizability, allowing other institutions to adapt this framework to different engineering disciplines facing similar skill gaps.

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