Energy Technology Commercialization and Entrepreneurship: Insights From the U.S. Department of Energy's Office of Technology Transitions 2024 Energy Technology University Prize Faculty Track

Brittany Speetles, Daniel Zimny-Schmitt, Kristin Wegner Guilfoyle, and Joseph Simon

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List of Acronyms

ARL	Adoption Readiness Level
CARAT	Commercial Adoption and Readiness Assessment Tool
DEI	diversity, equity and inclusion
DOE	U.S. Department of Energy
ETCE	energy technology commercialization and entrepreneurship
EnergyTech UP	Energy Technology University Prize
LPS	Lab Partnering Service
NREL	National Renewable Energy Laboratory
OTT	Office of Technology Transitions
STEM	science, technology, engineering, and mathematics

Executive Summary

The U.S. Department of Energy (DOE) Office of Technology Transitions' (OTT) 2024 Energy Technology University Prize (EnergyTech UP) challenged student teams to compete for $450,000 in cash prizes for successfully identifying a promising energy technology, assessing its market potential, and creating a business plan for its commercialization. New to the 2024 competition was the EnergyTech UP Faculty Track, which tasked individual faculty members (or faculty teams) to compete for $100,000 in cash prizes for the successful development and implementation of educational activities (e.g., coursework, accelerators, programs) that introduce or expand energy technology commercialization and entrepreneurship (ETCE) topics at their institutions.

The EnergyTech UP Faculty Track aims to increase the commercialization of emerging energy technologies and foster innovation in ETCE education by leveraging the expertise of faculty to create robust, practical, and inclusive learning experiences. The rules for the program specified that the faculty submissions would inform a publication to be developed by NREL and OTT following the conclusion of the competition.[1] Building off the content submitted by faculty participants in ETUP 2024, the goal of this publication is to serve as a reference to help faculty across the nation build ETCE educational activities for students at their institutions.

The EnergyTech UP Faculty Track included a total of 122 eligible faculty team members throughout two phases: an initial Explore Phase to encourage idea growth, and a final Implementation Phase, wherein faculty were expected to submit developed proposals that they had worked on throughout the competition. In the Explore Phase, 51 eligible faculty teams competed for a total of $40,000. Ten faculty were chosen as Faculty Explorers and were awarded $4,000 each. In the Implementation Phase, 15 eligible faculty teams competed for a total of $60,000. The national prizes included a $25,000 first-place prize, a $15,000 second-place prize, a $10,000 third-place prize, and five faculty runners-up who were each awarded $2,000. Over 120 pages of material and content were received in the Implementation Phase and were used to inform this report.

The strategies detailed by faculty in their proposals touch on several broad themes of curriculum development, including multidisciplinary experience, interactive experience, modularity and flexibility, and diversity, equity, and inclusion. These themes are summarized in the paragraphs below, and an overview is presented in Figure ES-1.

[1] According to the EnergyTech UP rules document: "The content provided by faculty in the Implementation Phase is expected to inform a toolkit. The toolkit will be developed by DOE following the conclusion of this competition. The toolkit will be designed to potentially help other faculty across the nation that are interested in building entrepreneurship and commercialization activities at their institutions." The full rules document is available on HeroX: https://www.herox.com/EnergyTechUP2024/resource/1427.

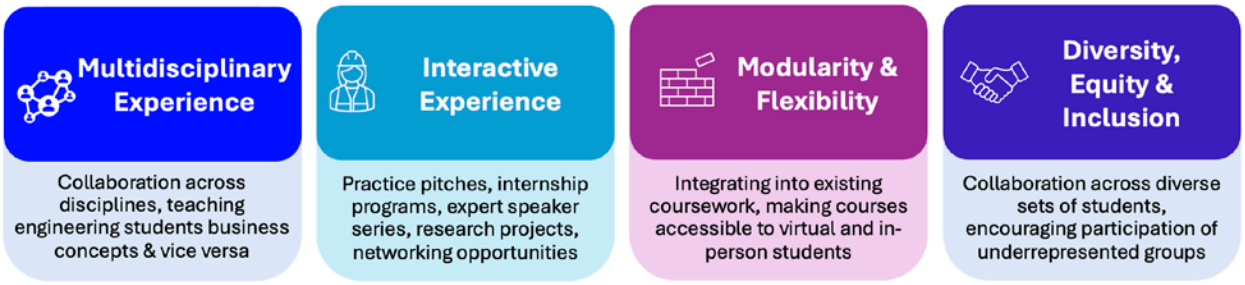

Figure ES-1. Themes present in Faculty Track proposals

Multidisciplinary Experience: A common theme that was articulated in the Faculty Track proposals was a focus on helping engineering and technical degree-seeking students build capabilities within the business or social science sides of ETCE topics, or vice versa. Proposals often encouraged students from different disciplines to work together on projects, e.g., researching and composing a business pitch for a specific energy technology. In many proposals, the implicit goals of multidisciplinary experiences included promoting energy technology literacy across majors and cultivating a culture wherein collaboration is welcomed, rewarded, and expected.

Interactive Experience: Most faculty applicants incorporated interactive learning opportunities, such as research projects, external partnerships, research fellowships, and practice business pitch competitions, into their proposals. For example, one faculty member proposed a research fellowship program focused on ETCE topics, and several others presented mock energy technology business pitch competitions as part of their implementation plans. Many applicants cited student career development in the energy industry as an implementation goal. Additionally, many noted the increasing industry demand for clean energy and climate-focused jobs and the growing interest among college students in clean energy technology and policy that make this goal timely. The International Energy Agency's most recent World Energy Outlook report states that the demand for renewable energy-related skills is growing by 5% annually (IEA 2024). In the United States alone, electric power generation employment grew by 4% in 2023, and clean energy technologies accounted for 79% of that growth, according to the U.S. Energy Employment Report (IEA 2024; DOE 2024). These trends also align with growing student interest in clean energy career paths; one study found significant parallels between the rising student interest in clean energy education and the increasing demand for clean energy jobs (Kumar et al. 2024).

Modularity and Flexibility: Modular and flexible educational activity design can help with smooth implementation in several ways. First, multiple implementation stages (i.e., initial pilot, full course, expansion to other universities) and integrated modularity in course design can help to incorporate iterative feedback throughout scaffolds. Second, modularity can help ensure that educators and students are prepared for unforeseen circumstances that could necessitate shortening or lengthening the course or moving to virtual settings (such as the COVID-19 pandemic). Third, modular course design can support the integration of selected topics into existing coursework, circumventing the necessity of preparing and undergoing approval for a new course. Finally, modularity and flexibility can make educational activities effective for educating students in different disciplines (i.e., business, engineering, social science) about ETCE topics.

Diversity, Equity, and Inclusion (DEI): Several faculty applications specifically outlined the goal of addressing the underrepresentation of protected groups such as women and people of color in engineering and business while working to create more engaging environments for those groups. In the prize rules, DEI was highlighted as a focus area of EnergyTech UP, and many faculty chose to emphasize these topics in their educational activities. It is unclear to what extent the language in the rules played a role in applicants' decision to focus on DEI in their proposals, versus applicants' independent intent and desire to do so. Studies demonstrate that ETCE programs can increase the retention of women and minorities in science, technology, engineering, and mathematics (STEM) education, meaning that underrepresented students could feel more welcome within their disciplines with the introduction of ETCE programs, making them more likely to be key participants and leaders in industry (Serrano et al. 2023; Dzombak and Mehta 2017).

Along with the common incorporation of the four broad themes listed above, proposals submitted to the Faculty Track also covered a wide range of topic areas, indicating a variety of cogent pathways toward impactful ETCE educational activity design. Although proposals needed to focus on ETCE topics, the Faculty Track was open to a range of educational strategies that varied in terms of scope, complexity, integration level, level of required support, and associated financial needs. Proposals ranged from intensive approaches (such as developing a new course or certificate program) to survey-style approaches (such as hosting an expert speaker series or integrating interactive projects and research about ETCE into existing coursework). Additionally, the Faculty Track applications explored a variety of topics; some proposals involved broad, seminar-level overviews of the ETCE space, whereas others aimed to expose students to the details of technology commercialization by focusing on specific concepts, such as intellectual property education or "valleys of death" for startup businesses. Still others took a "train-the-trainer" approach and proposed that educating other faculty on technology commercialization or intellectual property could have lasting impacts across the entire institution. The full scope of strategies explored in Faculty Track applications are outlined in Section 3 of the report.

Furthermore, different strategies proposed in the Faculty Track may require different levels of commitment on the part of the faculty member, the sponsoring department, and the academic institution. For example, a virtual speaker series or a mentorship program may be done within existing budget frameworks and could likely be organized within several months, whereas creating a new course or certificate program may require a multiyear lead time, iterative feedback, additional devoted resources to support initial implementation, continued operations, and more buy-in from institutional leadership. Figure ES-2 categorizes the educational activity strategies proposed by faculty by their likely level of effort.

Figure ES-2. Possible strategies and relative levels of effort

This evaluation of 2024 EnergyTech UP Faculty Track applications and follow-up interviews aims to support future EnergyTech UP Faculty Track applicants as well as others who are interested in promoting, developing, and/or implementing educational activities that focus on energy technology commercialization and entrepreneurship at their institutions. By presenting insights from the 2024 entries to the Faculty Track, the authors hope to contribute to a growing inventory of open-source curriculum development resources and provide materials to facilitate the growth of similar programs at a variety of collegiate institutions.

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1 Introduction

This report summarizes the themes, strategies, and impacts identified in proposals from the Energy Technology University Prize's (EnergyTech UP's) inaugural Faculty Track. The intention of this report is to develop a resource for future applicants and others interested in developing energy technology commercialization and entrepreneurship (ETCE) educational activities at their institutions, as well as to inform the U.S. Department of Energy (DOE) about how the program can continue to evolve and improve. The primary data for these insights came from the Faculty Track submissions themselves. In 2024, over 100 faculty members from more than 50 faculty teams submitted proposals focused on developing ETCE educational activities at their institutions. Faculty proposals were written documents that outlined the faculty or faculty team's concept for an ETCE educational activity, including aspects such as motivation, expected impact, challenges, and institutional support. Many of these proposals, which ranged in focus from new coursework to guest speakers to collegiate incubators, have moved forward since the competition ended in April 2024. The remainder of this document is organized as follows. Section 2 provides background about EnergyTech UP and the organization of the Faculty Track. Section 3 provides information about the wide range of strategies that faculty applicants proposed for ETCE educational activities. Section 4 highlights how faculty have been impacted and have moved forward through conversations held post-competition. Section 5 outlines the support that faculty may require beyond and after EnergyTech UP. Finally, Section 6 provides a brief conclusion and next steps for this work.

2 About the Energy Technology University Prize

EnergyTech UP was established in 2022 with the goal of challenging student teams to develop impactful business plans for energy technologies of their choosing. It is part of the American-Made program portfolio and is funded by DOE's Office of Technology Transitions (OTT) and administrated by staff at the National Renewable Energy Laboratory (NREL). The program builds on DOE's significant historical investment and NREL's experience with collegiate competitions, with more than 10 unique efforts over 20+ years.

OTT catalyzes the commercialization of energy, industrial, and manufacturing technologies that support the 21st century economy. Whether originating in the Department of Energy's National Lab complex or the private sector, OTT works to move innovation from concept to tangible solution that is successful in the marketplace. The office mission is to benefit the American public by driving economic growth, strengthening energy security, and boosting the United States' global technological leadership. The EnergyTech UP program is one of many commercialization-focused programs offered by OTT.

Since its inception, the annual EnergyTech UP program has attracted applications from over 500 teams and approximately 1,948 students across nearly every U.S. state and territory, awarding over $1 million in funds to student teams. In 2024, the prize expanded to include a Faculty Track, which invited faculty members from degree-granting institutions across the United States to design ETCE curricula or educational activities.

The 2024 Faculty Track was composed of three phases: the Explore Phase, the Develop Phase, and the Implementation Phase. These phases are summarized in Figure 1.

Figure 1. The 2024 Faculty Track phases of EnergyTech UP

The Explore Phase of the Faculty Track is intended to encourage faculty who are interested in implementing ETCE educational activities at their institutions, but whose home institutions have limited institutional knowledge, resources, or experience in ETCE. In their Explore Phase proposals, each faculty applicant outlined their initial ideas and identified opportunities for new educational activities or curricula in the ETCE space.

DOE selected 10 Faculty Explorers based on the faculty's identification of five criteria in their proposal: (1) the unmet opportunity, (2) the likely benefit to students, (3) the requirements for

success, (4) the anticipated challenges, and (5) the support from institutional leadership. The Explore Phase was judged by analyzing these criteria related to the proposals' suggested content and rating several evaluation statements on a scale of 1 (strongly disagree) to 6 (strongly agree). Selected Faculty Explorers were awarded $4,000 each for the quality of their initial plan and were encouraged to continue advancing their idea. Faculty Explorers also gained increased visibility for their success through a letter of congratulations sent to contacts at their institutions. Feedback from faculty after the competition indicated that this recognition was a valuable way to start proactive conversations with institutional leadership and advance their proposals.

The Develop Phase offered tutorials, resources, and mentorship to any interested faculty in the three months after Faculty Explorers were selected. The support and resources shared throughout this phase were available to *all* interested faculty (not just Faculty Explorers), meaning that all faculty who applied to the Explore Phase and/or indicated their interest via a separate online interest form were notified about Develop Phase events and resources. Each faculty competitor was assigned a mentor in the ETCE space and was encouraged to incorporate OTT content into their Implementation Phase application. This content included the Adoption Readiness Level (ARL) framework and the related Commercial Adoption and Readiness Assessment Tool (CARAT), which help identify a technology's readiness for commercialization at scale; the Lab Partnering Service (LPS), which helps connect institutions to National Laboratories and contains a database of National Laboratory patents and technologies; and the Pathways to Commercial Liftoff reports, which are a series of reports that identify how commercialization might occur for emerging zero-carbon energy technologies.[2,3,4,5,6] No prize money was awarded in this phase.

The Implementation Phase tasked faculty competitors with developing a more detailed plan for ETCE educational activities or curricula, with required demonstration of institutional support. Eligible applicants competed for a total of $60,000 in prize money as part of the Implementation Phase. Fully 93% of applicants returned from the Explore Phase, including 80% of the previously selected Faculty Explorers. This return rate demonstrated that Faculty Explorers, as well as Explore Phase competitors who were not selected as Faculty Explorers, continued to find the competition to be a worthwhile use of time, regardless of their success in the Explore Phase. DOE judged the Implementation Phase according to five criteria: analysis of need, actionability, support from institutional leadership, potential impact, and overall implementation plan. As in the Explore Phase, judges rated evaluation statements on a scale of 1 (strongly disagree) to 6 (strongly agree).[7]

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[2] ARL framework: https://www.energy.gov/technologytransitions/adoption-readiness-levels-arl-framework
[3] CARAT: https://www.energy.gov/sites/default/files/2023-03/Commercial%20Adoption%20Readiness%20Assessment%20Tool%20%28CARAT%29_030323.pdf
[4] LPS website: https://labpartnering.org/
[5] Link to all the Pathways to Commercial Liftoff reports: https://liftoff.energy.gov/
[6] The EnergyTech UP student competition also awards and encourages the development of commercialization avenues outside of the National Laboratory network, but the LPS is a useful tool for participating institutions, students, and faculty that do not have access to or prior experience with ETCE-related research.
[7] For more information on how the Faculty Track was scored and judged, please refer to the 2024 rules document for the competition, available on HeroX: https://www.herox.com/EnergyTechUP2024/resource/1427

Additionally, the 10 Faculty Explorers selected in the Explore Phase showed prolonged success throughout the competition. Faculty Explorers won the first-, second-, and third-place prizes in the Implementation Phase, as well as two national runner-up prizes. This means that 50% of Faculty Explorers won a national Implementation Phase prize and that Faculty Explorers took home 90% of the total prize money that was available in the Implementation Phase. Further, participants who applied to both phases won seven out of the eight national prizes available and made up over 93% of the eligible applications in the Implementation Phase. Table 1 summarizes how the total prize pool for the 2024 Faculty Track competition was distributed in the Explore Phase and the Implementation Phase.

Table 1. Total prize pool for 2024 Faculty Track

Category	Amount	Number Awarded	Total
Explore Phase			
Faculty Explorers	$4,000	10	$40,000
Implementation Phase			
1st Place	$25,000	1	$25,000
2nd Place	$15,000	1	$15,000
3rd Place	$10,000	1	$10,000
National Runner-Up Prizes	$2,000	5	$10,000
Total Prize Money (Both Phases)			$100,000

3 Faculty Strategies

The breadth of the proposed collegiate programs and educational activities received in the 2024 Faculty Track demonstrates that there are multiple paths toward designing effective educational activities focused on ETCE topics. Faculty proposals' broad range of strategies included:

- Short or complementary coursework (e.g., integrating interactive commercialization projects into engineering and/or other relevant courses)
- New courses (e.g., designing and implementing a full new academic course)
- Student business plan pitch competitions
- Integration of ETCE education into a new certificate program
- Workshops or seminars with industry experts
- Methods to leverage existing intellectual property for entrepreneurial concepts (e.g., providing National Lab intellectual property for student teams to commercialize)
- Mentorship programs (e.g., connecting students to industry experts)
- External partnerships with industry or National Laboratories
- Visiting scholar programs between universities to foster the exchange of ideas
- Programs to educate other faculty about intellectual property licensing and commercialization strategies at their institutions
- Incubators or accelerators for students to develop and commercialize their ideas related to ETCE.

Many of the Faculty Track submissions included multiple strategies from the bulleted list above, whereas others were more targeted and included only one or two. A summary of how often the listed strategies were used in faculty submissions is shown in Figure 2.

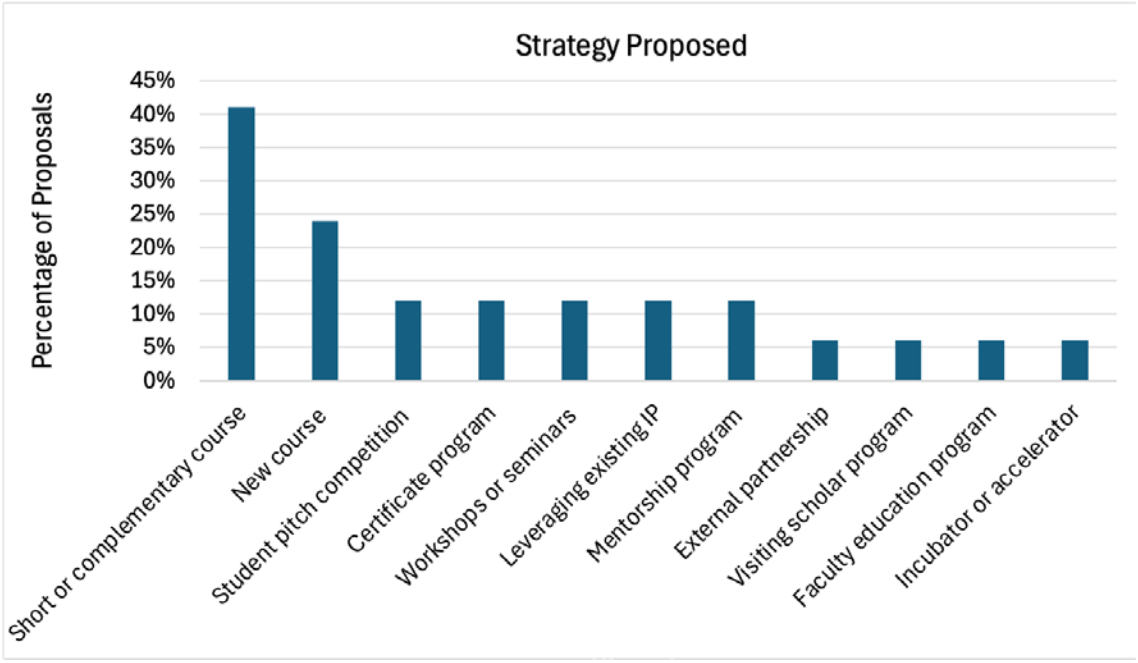

Figure 2. Strategies proposed by Faculty Track applicants

This figure includes all Faculty Explorers plus all eligible Implementation Phase applications, for a total of 17 Faculty Track proposals.

Figure 2 demonstrates that a variety of strategies were used by faculty applicants. Further, while the same strategies can look different across proposals, many proposals had common themes (multidisciplinary experience, interactive experience, modularity and flexibility, and DEI), summarized in Section 1, which were integrated into educational activities through the strategies outlined in Figure 2. For example, as shown in Figure 2, the most common strategy was designing short courses to complement existing courses, which often took the form of modules or electives. The second most popular strategy was the development of new academic courses, which often involved themes such as multidisciplinary collaboration, interactive experiences, modularity, and/or DEI. Interactive strategies, such as student pitch competitions, workshops and seminars, encouraging students to create business plans to leverage existing intellectual property, and mentorship programs with industry experts, also appeared, and more complex proposals, such as certificate programs targeting specific subject matter (e.g., intellectual property), might contain all four of the commonly used themes.

Submissions by Faculty Explorers reflected the wide array of strategies that can be used to further energy technology commercialization and entrepreneurial education of students across disciplines. Strategies selected by applicants also reflected the current needs and capabilities at each of the faculty's home institutions, which ranged from trade schools and small liberal arts colleges to larger universities such as R1 institutions. As noted in the Executive Summary, different strategies proposed in the Faculty Track are also differentiated by distinct levels of commitment on the part of the faculty member, the sponsoring department, and the academic institution. Sections 3.1 and 3.2 outline two examples of proposals that use a variety of strategies and touch on several of the themes outlined in Section 1.

3.1 Example Submission: Introducing New Energy Focus for Business Students

Summary: This case study focuses on a program for business students to learn about clean energy technology commercialization and entrepreneurship. Currently, the curriculum of the business school's energy program focuses solely on traditional energy sources. Although current students have close to 100% career placement in the fossil fuel industry, the faculty believes that business students who are interested in the energy field should have the opportunity to broaden their perspective to understand emerging energy technologies, various pathways for technology commercialization, and entrepreneurship opportunities. The plan involves a modular, two-pronged approach to promote clean energy exposure for business students: (1) required coursework, and (2) interactive experiences through outside partnerships and practice pitching.

Strategies Used:

- **New courses:** Related to the multidisciplinary experience theme, business school students learn about clean energy project strategies and development via new curriculum options.
- **External partnership:** Touching on the interactive experience theme, students are challenged to develop a partnership strategy with a National Lab to create a real-world analysis of an existing technology.
- **Student pitch competition:** Touching on the theme of interactive experience, students are expected to research an existing technology and create a business pitch for the selected technology, with timing aligned to the EnergyTech UP competition.

Challenges: The 100% career placement out of the energy program may mean that it will take more effort to convince leadership that investing in this program is worthwhile. Faculty could cite the increasing demand for clean energy jobs and changing student priorities and interests to justify the need for institutional leadership to endorse this program (Kumar et al. 2024). Faculty could enhance their proposal to improve or pursue ABET accreditation, which is a widely accepted credential in STEM fields.[8] Initial enrollment rates for this faculty program's pilot may also indicate growing interest in clean energy fields.

Outcomes: The plan aims to promote career development for students and build long-lasting institutional partnerships with the National Laboratory network, which would allow students to experience more activities and explore career paths related to business and clean energy technology. Currently, the proposal is in the first phase (developing and approving required coursework), and full implementation is expected to occur over a longer time scale.

3.2 Example Submission: Training Students to Translate Technical Concepts Into Marketable Ideas

Summary: This new, multidisciplinary, 10-week course will recruit students from STEM and business majors to teach them about energy technology commercialization in an interactive learning environment. The course will train students to explore and contribute to technological advances by encouraging entrepreneurial thinking and identifying market opportunities. Students will be recruited from undergraduate STEM programs as well as marketing, finance, and other business programs. Training will include intellectual property comprehension and assessment, market analysis and value proposition, and technology de-risking.

Strategies Used:

- **New course:** A new 10-week course will be co-taught by three professors with backgrounds ranging from specialized technical knowledge in the solar space to a focus on ETCE. This is strongly aligned with the multidisciplinary experience theme that shows up in many faculty proposals.
- **Student pitch competition:** Touching on the theme of interactive experiences for students, the final three weeks of this course are focused on preparing students for a business plan pitch competition held during the concluding week of the course.

Challenges: The development and approval of a new course, especially one that is a collaboration effort between departments, requires approvals at many levels by academic departments and university officials. Faculty could make connections to ABET accredited programs that contain similar coursework to strengthen their proposal and make the integration process easier.

[8] ABET is an organization that accredits collegiate programs according to quality standards in STEM disciplines. ABET originally stood for the Accreditation Board for Engineering and Technology but has operated solely under the ABET acronym since 2005 to reflect the organization's breadth across a wider variety of STEM programs including the natural sciences. ABET website: https://www.abet.org/

Outcomes: This plan promotes multidisciplinary career development, fostering collaboration between STEM and business students. The pitch competition will also provide student teams with interactive experiences in preparing business pitches to potential investors. The faculty team has hired two interns to help with implementation of the coursework and business pitch program.

4 Follow-Up Feedback From Participants

The NREL prize administrators moderated a follow-up conversation to understand how the eight 2024 faculty national winners and runners-up had advanced their ideas since submitting to the Implementation Phase in mid-April. This conversation took place four months after wrapping up the competition and collected faculty feedback on support, continued progress, impacts of participation, and lessons learned. Notably, faculty voiced that EnergyTech UP was an attractive program due to its low barrier to entry compared to grant applications and the incentive of a cash prize that would go toward the continued expansion of their ideas. Faculty also noted that working toward a fixed timeline with clear milestones helped them advance their ideas in a meaningful way. Critical feedback was limited, though some faculty presented ideas for a modified timeline to better align with the academic calendar.

Since submitting their Faculty Track Implementation Phase proposals, faculty have:

- Conversed with boards of trustees and institutional leadership to obtain approval for their ideas
- Taken steps toward establishing physical space and financial support to maintain their program
- Worked with external partners to finance plans
- Began new course development and pilot programs
- Prepared project rubrics to implement their ideas in existing courses
- Prepared written proposals for other awards/grants
- Created long-term plans to expand their ideas to other universities
- Spearheaded graduate research or internship programs for students
- Prepared students for student ETCE competitions.

Although full-scale implementation of ideas will take time, faculty winners vocalized that a range of benefits were realized through their participation in the competition. These benefits fell under several categories, which are described below. While these benefits may reference EnergyTech UP, they could also be applicable to other similarly structured prizes with fixed deadlines, clear deliverables, and shared goals. Even without the structure provided by a prize, faculty seeking to advance these topics at their institutions could consider other ways to pursue these activities to advance their ideas.

- **Motivating Idea Development:** Faculty winners voiced that the deadlines set by the EnergyTech UP competition encouraged them to fully develop their ideas for educational activities. Specifically, these deadlines motivated faculty applicants to think through and write about important issues such as course content, avenues of support, and potential challenges in their EnergyTech UP proposals.
- **External Recognition:** Success in the Faculty Track helped reduce administrative barriers and push faculty ideas into the planning stage. In certain cases, success and external recognition for faculty efforts helped convince institutional leadership to support an idea that had been proposed previously without success.

- **Networking:** Faculty winners noted that they were motivated to develop new connections throughout their institution, with several citing this as the biggest impact of the competition.[9] New or early-career tenure-track faculty, who are unfamiliar with the resources and work streams available at their home institutions, may see this as a benefit. Participation in the program gave winners the justification, or impetus, to reach out to new contacts, and in some cases, collaboration with other faculty members helped them strengthen their proposals during the Develop Phase. Faculty also leveraged the competition's connection to engage the broader National Laboratory network and DOE. Additionally, through webinars that took place throughout the competition, faculty had the opportunity to connect with other EnergyTech UP participants.
- **Access to Resources:** Throughout the competition, resources such as DOE's published ARL and CARAT frameworks were made available to faculty applicants, and EnergyTech UP hosted several webinars with personnel from the National Laboratories, DOE, and the American-Made Network.[10] The connection with DOE and the National Laboratory network was seen as a helpful way to leverage partnerships and resources, and a way to guide students who are interested in participating in student ETCE competitions such as EnergyTech UP.
- **Preparing Students for the Student Competition:** Pitch competitions were a strategy outlined in several of the Faculty Track proposals. One faculty winner included student interns as part of their strategy to promote their institution's leadership and success in the EnergyTech UP competition specifically. This is a career development strategy that relates to the theme of interactive experience in faculty proposals and gives students the experience of mentorship and leadership in ETCE topics.
- **Exploring Energy Curricula:** Several faculty winners expressed that while they did not have a strong energy background before applying for the competition, the competition piqued their interest in the energy space and in teaching students about energy technologies. Others expressed a similar sentiment, saying that their work and research touched on technology commercialization and entrepreneurship, but that the competition gave them the motivation to incorporate clean energy into their coursework. With the higher demand for clean energy and sustainability careers as well as an increase in student interest in these areas, this competition's contribution toward promoting more energy-focused education at institutions is seen as a significant positive impact.

Figure 3 provides specific quotes from faculty related to each of the benefits described above.

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[9] Building connections occurred in different ways. Faculty disseminated information about their programs as a resource, spoke to others at their institution who had similar research interests, and spearheaded workshop programs that included energy and entrepreneurship training. Collaboration also helped some faculty strengthen their ideas throughout the competition phases; one faculty member who submitted an idea to the Explore Phase but was not selected as a Faculty Explorer teamed up with a colleague, made improvements to their plan, and was selected as a national runner-up in the Implementation Phase. One faculty winner scheduled a guest speaker from DOE as part of their implementation plan for student educational activities.

[10] The American-Made Network is a network of 450+ members that provides wraparound services to help prize applicants take an idea to business by connecting, mentoring, and educating students. American-Made Network members include industry leader groups, National Labs, industry, and incubators/accelerators to accelerate ideas, partnerships, and progress.
More information about the American-Made Network: https://americanmadechallenges.org/network

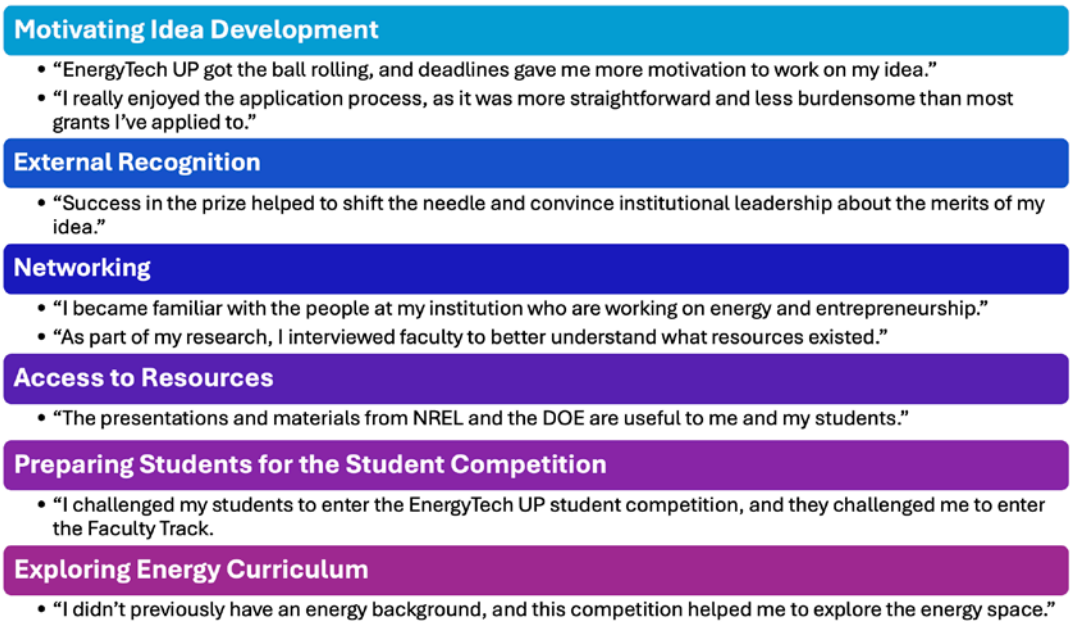

Figure 3. Benefits and quotes from faculty feedback

5 Types of Follow-On Support Valued by Faculty

Many of the ideas proposed in the Faculty Track will take significant time and resources to reach full implementation and will require different avenues and levels of support beyond the EnergyTech UP competition. Five support strategies were consistently mentioned by faculty applicants to move their proposals forward after completing EnergyTech UP: advising support, technology transfer, financial resources, physical space, and materials. These are summarized in Figure 4.

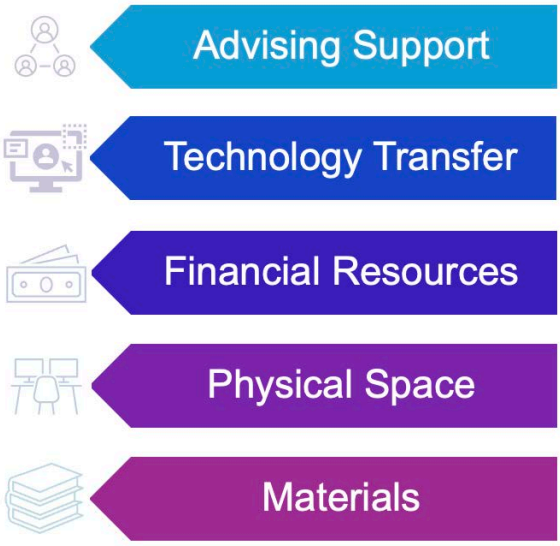

Figure 4. Types of support needed

- **Advising Support:** Faculty entries consistently reported that support from other faculty mentors across technology and business schools would be important to ensure the success of a newly developed program and would help with milestones such as course approval and advertising the course to students. Collaboration and partnerships with other faculty members, industry, government, and businesses can strengthen energy technology commercialization and entrepreneurial programs. Industry partners can provide mentorship and skill development, such as helping students assess product-market fit, develop their company pitches, and gain valuable business and entrepreneurial connections—all of which are interactive experiences that foster career development for students. Energy technology commercialization and entrepreneurial programs, such as clean energy technology incubators and accelerators, can further support students in developing their skills and networking with entrepreneurial and investor ecosystems.
- **Technology Transfer:** Depending on what type of educational activities are being planned, technology transfer is an area where support may be needed. Faculty may need to gain expertise in intellectual property management to advise students interested in commercializing energy technologies. Some faculty members noted that there is not a comprehensive understanding of how technology transfer occurs at their institution, and many institutions have unique processes related to intellectual property. One faculty member aimed, through their proposal, to teach other faculty at their institution about the constraints

and opportunities related to their technology transfer department and then integrate these resources into teaching about ETCE.

- **Financial Resources:** University faculty are often responsible for gathering funds for their ideas through avenues such as grants, donations, or other investments. In the follow-up conversation with faculty, funding was commonly expressed as an area where faculty winners would require additional support to reach full implementation of their ideas.
- **Physical Space:** Regardless of the educational activity strategy, physical space is a likely requirement for any ideas, and often requires coordination with and support from institutional personnel. Physical space on a college campus may include offices, innovation laboratories, and classrooms to host newly developed programs.
- **Materials:** Online modules, textbooks, manuals, and other supportive materials are requirements of a traditional college course. Using modular materials and materials that are flexible to virtual and in-person activities can be useful to extend coursework to other universities and audiences.

6 Looking Forward

The 2024 EnergyTech UP Faculty Track awarded a cumulative $100,000 across two main phases to faculty winners who submitted proposals to expand or spearhead ETCE educational activities for students at their institutions. This report used approved information from faculty applicants and winners to enable broader learnings about ETCE training and programming at collegiate institutions. An analysis of the faculty proposals indicated that faculty strategies tended to include at least one of several broad themes, such as multidisciplinary experience, interactive experience, modularity and flexibility, and DEI. Proposed faculty strategies included creating a new course, adding on to an existing course, creating mentorship programs, and establishing research rotation programs. These approaches were each associated with distinct levels of necessary support and resources. The review of commonalities across the faculty winners indicated common approaches across the whole spectrum of program intensities and an emerging effective contribution to energy entrepreneurial education.

As faculty advance their strategies, they look forward to full-scale implementation of their ideas. Because many project timelines are a year or longer and may take place through iterative processes, the impact of the inaugural Faculty Track competition remains to be fully realized. For example, one faculty member has a multiyear plan to advance their idea, which involves incorporating DEI opportunities through ETCE education, a pilot program, a full-scale program at their institution, and then an expansion to other institutions. There are potential action steps that could improve the scaling of impact of the Faculty Track, such as post-competition success, including the possibility that faculty secure additional funding, and additional data collection for follow-on understanding of implementation.

Additionally, as discussed in Section 4, different types of institutional support post-competition may be necessary to reach complete implementation of submitted faculty strategies. For example, one faculty member is looking forward to raising and maintaining the funding that will allow them to maintain the physical space necessary for an energy incubator program. Conversations with faculty after the competition helped us understand that while parts of implementation plans are still ongoing and may require other forms of support, many have made significant progress in introducing or expanding ETCE topics at their institutions.

Although all of the faculty winners, who the authors of this report spoke to after the competition, expressed that they would continue seeking to advance the implementation plans they submitted, it is possible that some faculty who competed in EnergyTech UP will not continue to advance their plans. The extent to which faculty reach full implementation of their proposed ideas is an area of future research. Understanding the percentage of faculty who implement their ideas is an area of interest because it could improve prize design and efficiency of federal investments in prizes.

This analysis provides a better understanding of faculty patterns and priorities related to educating students about ETCE career paths, and outlines faculty-designed paths forward for efficient and strategic approaches to ETCE at institutions. As the faculty competition continues to grow in future years, these insights may provide a useful resource for faculty at institutions who are interested in educating future energy leaders about clean energy and entrepreneurship, and for those who seek to support more ETCE at their institution. Faculty members who seek to

advance their ideas can benefit from identifying the support needed at their institution, the integration into accredited programs, and the involvement of students at various levels of commitment, from seminars and workshops to new academic modules and courses.

One limitation of this prize program is that despite outreach efforts, no two-year colleges were represented in the inaugural Faculty Track. Given the growing need for workforce development in ETCE topic areas, students and faculty at two-year colleges as well as trade schools are likely to represent important groups within the higher education system and unique data points that may have a series of distinct needs and insights (IEA 2024; DOE 2024). The EnergyTech UP program will aim to conduct outreach and engagement efforts to two-year colleges and trade schools as the competition evolves. If two-year college or trade school faculty apply to future EnergyTech UP Faculty Track prize programs, future reports will include those applicants in the overall dataset.

The inaugural Faculty Track of the EnergyTech UP reduced barriers to implementing ETCE educational activities at collegiate institutions by awarding a total of $100,000 to collegiate faculty across the United States and providing resources and guidance to faculty applicants. This analysis uses the information from that prize to scale understanding and increase the impact of ETCE opportunities at non-participating universities. Further, this report presents just one of many opportunities for the type of analysis that can be conducted through the American-Made prize mechanism. Future program analyses will work to understand the impact of the Faculty Track competition by analyzing how curriculum strategies resonate with students, how the EnergyTech UP faculty and student competitions interconnect, and how to continue to respond to collegiate faculty needs.

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