My daughter finished her second year of high school this spring, and we have started thinking seriously about her future: higher education and, beyond that, career paths. Although her chromosome origins are the product of two engineers, she is rather serious about medicine as her future profession. Because of my firm belief that engineering is the future (and the slightly vain desire to have her follow in my footsteps), I suggested that she first obtain a bachelor’s degree in engineering before pursuing her medical studies.

After all, I argued, engineering is not only the future of medicine; it will be used in the future to obtain food, clean water, and electricity for the planet. For example, in 2017, the IEEE introduced a new technical topic called food engineering, to play an active role in “the worldwide technological and social challenge of preparing a healthy and enjoyable future for mankind on Earth (and in exploring new planets).” The food engineering topics are multidisciplinary and collect engineering knowledge and practices to innovate efficient, safe food production and delivery methods that can impact billions of people.

But even if a teenager upsets the natural order of things and listens to her mother, her journey through engineering education and careers will look nothing like my own experience. The engineers of tomorrow will have to collaborate across disciplines in new ways to create solutions for problems that don’t even exist yet. The world’s power systems are no different. New communication and information technologies previously not employed in the power industry have made the grid more resilient, intelligent, and capable of self-healing. Add to this the growth of interest in renewable energy resources, and we have a never-before-seen obstacle in front of power engineers today.

### Disruption in Power Education

Changes in the power industry itself create a parallel set of challenges for electrical power education. In addition to teaching traditional power system courses, colleges and universities now need new courses in power electronics, information and communications technologies, policy, and economics, to mention a few, while still ensuring students graduate within the traditional four-year time frame.

As their curricula become more high tech, many colleges and universities are also embracing technology to make program delivery more accessible. Numerous courses that were once only available in a face-to-face environment are now being offered online, allowing for a more flexible, self-paced learning experience. In the United States, we are witnessing a growing interest in online bachelor’s and master’s degrees in electrical power education. There is also an increased demand for continuous education in the existing power and energy workforce in the form of webinars and tutorials relevant to the smart grid.

Throughout this issue, you will learn how different countries are rising to meet these academic needs in power education. For example, the Italian education system adopted the “Bologna system,” or “3 + 2,” where a bachelor’s degree is awarded after three years, and the second or master’s-level degree is awarded after the next two years. For one to obtain the third-level or doctorate degree, an additional three years are needed. Italian universities are committed to offering reduced tuition, depending on the income of the student’s family, thus offering affordable education to all regardless of economic status. Models like this, if employed worldwide, could greatly improve racial, gender, and class diversity in the world of electric power.

### The Changing Face of the IEEE

The betterment of humanity depends on inclusion, engineering, and education (IEEE). Sound familiar? If it does, you are most likely an engineer who enjoys history and remembers the beginnings of the IEEE.

Back in the late 19th century, a group of technically inclined individuals met in New York City and formed the American Institute of Electrical Engineers (AIEE). The group’s mission was to apply innovation for the betterment of humanity. The word “American” was dropped for good from the title back in 1963, when the AIEE merged with the Institute of Radio Engineers to form the IEEE.

Back in the 1980s, the IEEE was the world’s largest technical professional organization with a membership of 417,429 (according to the IEEE’s membership development report from December 2017), and
the IEEE Power & Energy Society (PES) has a membership of almost 40,000 as of 31 December 2017, with an annual growth rate over 5%. Figure 1 shows this growth as well as the annual drop in PES membership numbers by mid-February, which then rebounds as people renew their memberships in the first two quarters of the year.

As an industry, we continue to ponder how to solve the puzzle of power professionals retiring without proper replacements. I am happy to share good news in this regard; in 2017, annual PES student membership was 34% higher than in 2016. Table 1 shows PES memberships by grade and region. In 2017, the number of PES Student Members was 7,365, compared to 5,587 in 2016. This trend indicates that PES is on the trend to become a young, thriving association once again. Many thanks to Juan Carlos Montero, PES vice president of Membership and Image, for providing IEEE and PES membership numbers, including Figure 1 and Table 1.

As PES becomes an organization with younger members, it is also becoming more diverse. This is why I chose to highlight IEEE in this article. Although the beginnings of the IEEE were predominantly associated with white men, we are changing with the rest of society to include more minorities and women of all ethnicities. As of December 2017, the IEEE Women in Engineering (WIE) membership was 22,968, or 5.5% of the total IEEE membership number. Not all IEEE women members belong to WIE, so the total percentage of women in the organization is slightly higher. Nevertheless, are we to be satisfied with these numbers? We owe it to the industry to work toward even greater inclusion for all qualified professionals, regardless of their gender, ethnicity, geographical location, and religion within IEEE and professional societies in general.

**PES: Keeping Pace with an Evolving Industry**

PES is actively engaged in continuous education by offering numerous and timely technical documents, white papers, webinars, and tutorials accessible online to its members via the PES Resource Center (http://resourcecenter.ieee-pes.org/). Many of the PES online webinars and tutorials come with education credits (continuing education units/professional education credits).
development hours) for those who need to maintain professional engineering license requirements. Moreover, for a growing number of professionals working in the power and energy industry but with no power engineering background, PES organizes Plain Talk workshops where technical aspects of the electric power system are explained in easy-to-understand terms. All of these activities are branded within the PES community as PES University.

Back in 2016, PES organized a new committee, New Product Development (NPD), with the objective of managing and overseeing the policies, operations, development, and marketing of PES online and face-to-face continuing education products. Two NPD subcommittees, Webinar and Tutorial and Plain Talks, are responsible for the production of webinars, tutorials, and plain talks, respectively, while the third subcommittee, called Selection and Quality Control, oversees the quality of all continuous education products under the PES University brand. It is important to mention that the NPD committee and subcommittees are populated with industry and academia PES members. PES continuing education products are created for PES members who seek to maintain and improve their engineering skills in this fast-paced environment of the smart grid.

In addition, there is the long-standing PES Power and Energy Education Committee (PEEC) with a scope that includes improving relationships among all segments of the power industry and all elements of the engineering education community. PEEC also supports “research and researchers at universities and encourages the support, dissemination, and use of university research in power engineering.” More on PEEC can be found at its website: http://sites.ieee.org/pes-peeec/.

The PEEC subcommittee that PES Graduate Student and Student Members are most familiar with is the Power and Energy Student Activities subcommittee. This subcommittee, with the support of local conference committees, organizes programs for international and domestic students for the following North American PES conferences: IEEE PES Transmission and Distribution Conference and Exposition (T&D), General Meeting (GM), and North American Power Symposium. In 2016, PES sponsored housing and registration for 260 international and domestic students in Regions 1–7 (North America) for the GM. In addition, PES sponsors student conference activities and maintains a budget for that purpose in Regions 8–10.

This year, for the first time ever, PES also organized a contest for area high school students during the T&D North America Conference in Denver. This contest was a pilot project in an effort to increase science, technology, engineering,
and mathematics (STEM) interest in high school students and provide them with opportunities to learn new skills, network, and interact with energy industry professionals. The high school students were active and equal participants in the PES student-sponsored activities, including the Student Poster Session and Reception, and members of a winning high school team were awarded scholarships toward full-time STEM study at the accredited two- or four-year college or university of their choice. These students can use the scholarship for tuition, fees, books, or supplies. PES also organized a chaperoned tour around the T&D exhibition hall for PES student members and high school students (Figure 2).

In 2011, PES provided seed money for the first PES scholarship program for power engineering undergraduate students in Regions 1–6 (https://www.ee-scholarship.org/). The PES Scholarship Plus Initiative provides scholarships and real-world experience to undergraduates who are interested in power and energy engineering careers. The ultimate aim of this initiative is to attract highly qualified engineering students to the field and help replace the retiring power and energy workforce with new talent. The program has been maintained with PES volunteers and power and energy industry funds from Regions 1–6. In 2015, a similar PES scholarship initiative was established in India (http://ieee-pes-ipisa.org/). In 2016, the Italy PES Chapter instituted the IEEE PES Italy Scholarship Award Fund with the aim of attracting bright and meritorious students to power engineering. IEEE PES

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LF: Life Fellow; F: Fellow; LSM: Life Senior Member; SM: Senior Member; LM: Life Member; M: Member; AM: Associated Member; GSM: Graduate Student Member; StM: Student Member; AF: Affiliate Member.
has established and currently maintains a budget for PES Regions 8–10 to provide seed money for self-sustainable student scholarship initiatives.

In This Issue
This issue of IEEE Power & Energy Magazine is dedicated to power engineering education worldwide. The most recent PECC survey, conducted during the 2015–2016 academic year, as well as findings of 15 prior university surveys of power engineering education resources since the 1969–1970 academic year indicates how well Canadian and U.S. universities have responded to these changes. The survey’s objective was to promote power education and research in these two countries by reviewing current research topics as well as sources of funding. For example, the most recent survey shows that U.S. governments provided almost 70% of research expenditure, with the rest almost equally divided between utilities and other industry funding. The survey reveals an expansion of the power engineering curriculum into nontraditional subjects addressing power and energy industry changes. The PECC survey results are summarized in article “Trends in Electric Power Engineering Education.”

In “Power Engineering Education,” we get a brief review of power engineering education in India and how in a mere 100 years since 1917—when the first Indian university offered electrical engineering courses—Indian power and electrical education, in general, has grown tremendously to a total intake capacity of 1,324,246 engineering students during the 2010–2011 academic year. As the proverb says, “It takes a village to raise a child,” it takes the whole country and every citizen’s dedication to education to achieve such an undertaking in electrical engineering education. A long list of core and elective courses in power engineering offered in India is presented in this article, ranging from traditional power systems courses to interdisciplinary and specialized offerings needed in today’s power systems. Their holistic, forward-thinking approach has led to strong student interest and a worldwide demand for Indian students and professionals.

“Electric Power Engineering Education” offers a description of third-year B.Eng. and fourth-year M.Eng. degrees in electrical and electronics engineering (EEE) in the United Kingdom. To obtain entrance for a B.Eng. degree in a leading EEE university, an A (grade higher than 90%) is required in relevant General Certificate in Education courses like mathematics and physics and high grades in other relevant high school courses. The British government offers funds that cover tuition fees and an enhanced living stipend to doctorate degree students. The stipend has been offered for an initial period of five years to British and European Union nationals who have had residency in the United...
Kingdom for at least three years. (For a summary of the Italian portion of the article, see the section “Disruption in Power Education”).

“Electrical Power Engineering Education Down Under” discusses the PEEC survey and the state of power education in New Zealand and Australia. It was interesting to learn that electricity’s beginnings “down under” coincided with its beginnings in the United States. In 1882, Brisbane was one of the first Australian cities to start using electricity commercially, thus making it comparable with New York City. In both countries, a bachelor of engineering degree is awarded after four years of study, where the first two years are composed of general engineering courses, and the third and fourth years are dedicated to courses with a strong power systems curriculum. Given that the education systems in English-speaking countries are more or less similar to the North American education system and there was strong interest among power engineering colleagues in Australia and New Zealand, PES plans to extend a slightly modified PEEC survey to these two countries in the first phase. On the basis of the success of this trial, the survey will then be gradually expanded into other PES Regions in successive phases.

Although internships for university students have been around for decades in the United States, it is becoming increasingly popular again as a way of screening and hiring perspective engineering employees. This practice benefits both sides of this partnership: industry has a way to screen potential employment candidates and develop relationships with universities, while students get a chance to engage in real engineering work while earning money to pay for their studies. The authors of “The Power of Internships” offer some tips to students planning their internships and give advice to industry on how to run a successful internship program.

Because of rapid retirement rates in the power and energy workforce and the hiring policies of the U.S. utilities industry for the past decades, the demand for power engineers has grown to such proportions that prospective employers are using different approaches to find and hire engineering talent. This climate has led to a rapid development of online education with U.S. universities offering online undergraduate and graduate power system courses. The article “Online Power Education” explores the pros and cons of American online education in power at this moment.

By the turn of the 20th century, many U.S. universities had either reduced substantially or extinguished power engineering programs due to low demand for new engineers in the U.S. power and energy industry. “Toward a 21st Century Power Education” describes a successful re-creation of the power engineering program at the University of Utah after many years of no or minor activity in this field. The intent of this article is not commercial; the authors tell the story in the hope that their experience will help those who engage in the same process.

The issue concludes with the “In My View” column, “Education Challenges.” The article summarizes the changes the industry has experienced in the last decade and the emerging new technologies and power engineering curricula that reflect the industry changes, albeit with a delay. One section of the article reviews the current status of power education in Africa and calls for a strengthening of ties between education stakeholders and industry. It is clear that, in every corner of the world presented in this issue, there is a continued need for power engineering curricula to better and more expediently reflect the changes in industry.

This issue on power education would not be possible without the hard work and insight from the authors who worked diligently on their articles and were very patient and responsive. Many thanks also to Editor-in-Chief Mike Henderson for his guidance and unwavering support. I hope the readers will enjoy, as I have, this review of power engineering education around the world.

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**Figure 2.** PES students visit the 2018 T&D Conference and Exhibition in Denver.