

## Environmental Engineering Science in the 21st Century

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**T**HE FOUR ARTICLES THAT COMPRISE this Association of Environmental Engineering and Science Professors (AEESP) board of directors-endorsed special issue on Environmental Engineering and Science in the 21st Century reflect one part of an extended and ongoing effort to bring the environmental engineering and science (EES) community together to consider the changing role of our field. As a discipline, EES has played a significant part in improving societal understanding of the intricacies of contaminant transport in ground and surface water, drinking water disinfection-by-product formation, air pollutant formation and control, and myriad other problems both large and small. Our community has much to be proud of as our efforts have either directly or indirectly contributed to the development of regulations and policies that protect people and ecosystems across the world from both pollution and other challenges that beset our increasingly populated world. Unfortunately, there is the very real possibility that the EES community could become a victim of our own success.

Across much of the developed world, water and air are now cleaner than they have been in generations, the ozone hole is shrinking, and many dire problems of the past (acid rain and atmospheric lead) are highly diminished in scope. Understandably, as these topics have declined in societal importance, the funding available to address these and other “legacy” challenges has similarly receded. At the same time, other areas of scientific and engineering inquiry such as chemistry, physics, medicine, and other engineering domains now regularly produce work that encroaches upon topics historically within the EES portfolio. Our community has shown resiliency against these tides by moving to emerging topics of interest (e.g., environmental fate of nanomaterials and applications of membrane bioreactors); however, in this era of tight budgets and performance evaluation plans, it nonetheless is pertinent to ask whether we as a community are stepping up to address the big problems and not simply focusing on nuance that provides sustained funding for each of our laboratories. Climate change mitigation and management, global public health challenges, clean and sustainable energy production, and sustainable water for all people are topics that scream for the attention of our community. In this light, a question that I personally struggle with, and that I think each of us should ask of ourselves, is how can the

research that we conduct ultimately contribute to solutions to these and other pressing problems?

It was with these thoughts in mind that this special issue was initially envisioned. The concept was to solicit contributions from people across the EES field that would move this important discussion forward. The authors were given leeway to choose topics of their own volition and to determine how they wanted to frame their contribution—whether it be more in the form of a review article, closer to an opinion piece, or somewhere in between. All of the articles were peer reviewed and subjected to the normal rigors of publication in *Environmental Engineering Science*. The topics broached by these four articles are diverse—ranging from the vastness of the world’s oceans and the problems they face to the challenges of modernization and consideration of the less fortunate, and finally to the issues that faculty face as we deal with funding issues and our own choices. Here are the highlights:

Boehm *et al.* (2017) in “Oceans in Peril: Grand Challenges in Applied Water Quality Research for the 21st Century” describe the plight of the Earth’s oceans and the threats that they face because of microbial, chemical, plastic, and other anthropogenic-induced inputs. Rising contaminant levels, significant declines in global ocean biodiversity, and increased invasive species impacts are all symptoms that attest to the growing scope of the problem. The authors conclude with a discussion of specific research activities that the EES community can undertake to contribute to improving ocean health.

Over the past 20 years, there has been rapid growth in the level of interest that the EES community has toward addressing environmental challenges in the developing regions of the world. In their contribution “The Grandest Challenge of All: The Role of Environmental Engineering to Achieve Sustainability in the World’s Developing Regions” Mihelcic *et al.* (2017) assess the progress that has been made and provide a roadmap to improve upon that progress. In particular, they suggest a set of ten environmental engineering grand challenges that will achieve environmental sustainability not only in developing regions but also across the earth.

Daigger *et al.* (2017) in their contribution “Transforming Environmental Engineering and Science Education, Research, and Practice” discuss the history of EES, the current model by which the EES community addresses pollution and environmental discharges, and a potential new “paradigm” that incorporates EES practice within society. They argue that the EES community should embrace integrated solutions that address multiple potential problems in as proactive a manner (as opposed to the current reactive model) as possible.

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In their contribution “Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition” Edwards and Roy (2017) step outside of the EES community and broadly consider how academic research integrity has the potential to be undermined by an increasing reliance on quantitative performance metrics. Edwards and Roy argue that too great of a focus on citation-publication counts, impact factors, and total research dollars has a detrimental effect on the research questions that individuals study and funding agencies support. The important questions and issues that Edwards and Roy raise are those that must be considered not only by the EES community but also by academic institutions, funding agencies, and society as a whole.

In closing, you might wonder why there are only four articles in a special issue dedicated to the state of EES in the 21st century—clearly there are many other issues that could have been addressed. The short answer to that question is that because of their wicked nature, many of the issues that the EES community is dealing with are hard to envision and discuss. At the outset of this effort, articles on topics as diverse as the microbiome, nanotechnology, energy production, and resource recovery were solicited; however, many of the authors who intended to submit articles on these topics were ultimately unable to do so, given the extreme challenge of writing such

open-ended articles given the many demands on people’s time. Given that fact, I must commend each of the authors who did contribute as their efforts were truly extensive. Similarly, on behalf of AEESP, let me close by thanking Editor Domenico Grasso, Deputy-Editor Catherine Peters, and Manuscripts Manager Dawn Densmore of *Environmental Engineering Science* for their longstanding support of this effort.

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