



A person wearing a white protective suit, safety glasses, and gloves is kneeling in a field, holding a clear plastic cup containing a brown liquid sample. The background shows a field with some snow or frost on the ground under a blue sky with light clouds.

ENVIRONMENTAL CONCERNS COAXING NEW LEVELS OF INPUT FROM P.ENGs

Environmental engineering has come a long way from its association as a nature-bound adjunct of civil engineering. But with new concerns about a changing climate, severe weather, risk assessment and faithful stewardship of all resources, environmental practitioners are poised for even more contributions to the public good.

BY MICHAEL MASTROMATTEO

B

Back in 2010, when the Ontario government brought in legislation aimed at increasing administrative efficiency and reducing bureaucratic red tape, PEO managed to work in a few changes to the *Professional Engineers Act* (PEA).

One of the less heralded changes at the time was adding the word “environment”

to the list of things to be safeguarded by the engineering profession. Previously, the engineering act only cited life, property, economic interests and the public welfare as among the engineer’s protective domain.

It was the first time the environment was explicitly stated as within the purview of engineering in Ontario. Semantically, the change might not have been necessary, especially if one assumes that care for the environment is effectively captured in the engineer’s commitment to “life, property, economic interests and the public welfare.” In a symbolic sense, however, the change engendered fresh thinking on what constitutes environmental engineering today, and if this area of practice has come to mean more than water quality, ecosystems, air emissions and pollution abatement.

Increasing public concern about climate change, greenhouse gas emissions, severe weather incidents, alternatives to fossil fuels and the emerging carbon economy have also put the spotlight on environmental engineers and precisely what it is they do.

Engineering Dimensions sought the views of several professionals, both within environmental engineering and from the outside, as to what may be at stake in this sensitive and politically-charged area.

On the climate change front, for example, there has emerged one school of thought contending that professional engineers could face charges of professional misconduct if they fail to warn policy-makers and government leaders to the dangers of greenhouse gas buildup in the environment. While this might seem alarmist to some, it adds a sense of urgency to the profession’s duty of care in matters of environmental protection and preservation.

Engineers Canada, the national association of Canada’s provincial and territorial regulators, has responded to this concern in a couple of ways.

Just last October, Engineers Canada released its *National Guideline on Sustainable Development and Environmental Stewardship for Professional Engineers*, which highlights the changing priorities in this sector.

“A purely environmental approach is insufficient, and increasingly engineers are required to take a wider perspective, including goals such as poverty alleviation, social justice and local

and global connections,” says the guideline. “This practice of sustainable development can be expected to evolve and engineering education and continuing professional development will need to include an understanding of sustainable development.”

In linking environmental engineering with the requirements of sustainable development, Engineers Canada sees significant changes on the horizon for the way environmental engineering is understood and practised. Says the same guideline: “Sustainable development is an emerging aspect of engineering practice, which is more comprehensive and anticipatory and in many areas is overtaking the more narrow discipline-specific activity of ‘protection of the environment.’”

David Lapp, P.Eng., FEC, practice lead, globalization and sustainable development at Engineers Canada, was one of the first to draw attention to the vital link between sustainability and environmental engineering practice. He says emerging concepts of asset management, life-cycle assessment and risk avoidance require new thinking on environmental engineering in practice.

INCREASING PUBLIC CONCERN ABOUT CLIMATE CHANGE, GREENHOUSE GAS EMISSIONS, SEVERE WEATHER INCIDENTS, ALTERNATIVES TO FOSSIL FUELS AND THE EMERGING CARBON ECONOMY HAVE ALSO PUT THE SPOTLIGHT ON ENVIRONMENTAL ENGINEERS AND PRECISELY WHAT IT IS THEY DO.

“I think the big thing that is relatively new is the whole notion of risk and vulnerability assessment and bringing that to the engineering process,” Lapp says. “Basically, in the past, we have been designing on the basis of past performance, and so forth, and now with one of our foundational elements shifting on us—and we don’t know how fast or how much is it shifting—it begs a different approach. Now we are seeing a focus on life-cycle thinking and how to get infrastructure to last a long time, taking into account shifting climate patterns. We need to find a way to deal with this and how it applies to practice.”

ACHIEVING A BALANCE

This need to take a fresh look at environmental engineering practice is reflected in one of the key recommendations of the Engineers Canada stewardship guideline: “[Engineers] should seek and disseminate innovations that achieve a balance between environmental, social and economic factors while contributing to healthy surroundings in the built and natural environment.”

An earlier Engineers Canada guideline on climate change also underscored the impact climate change and sustainability have on traditional thinking in the environmental engineering sector.

This guideline suggests it is critical the profession create conditions where climate change adaptation is not only an accepted part of daily practice, but also a guiding principle of professional practice. Individual engineers should make reasonable efforts to incorporate adaptation into their personal professional practice through continuing professional development and experience.

This, in turn, calls on engineers to communicate more effectively with decision makers about climate change adaptation issues and the associated risks. As part of this professional responsibility, the engineer should clearly communicate the costs and benefits of recommended actions and how those actions mitigate the identified risks. It is important the engineer clearly articulate the economic benefits of the adaptation measure and the potential costs of not adapting to the identified risks.

Jeanette Southwood, P.Eng., FEC, vice president for strategy and partnerships at Engineers Canada, agrees that climate change, sustainability, resilience, and better use of natural resources continue to influence what's expected of the environmental practitioner. "We must look through a broad lens that includes sustainability and resilience and, with our teams, be fully attuned to the social and economic considerations involved, as well as the environmental aspects," says Southwood, a former global sustainability leader at an international consulting firm, and a recipient of engineering awards from both PEO and the Ontario Society of Professional Engineers (OSPE).

Lapp says Engineers Canada intends to engage with engineering school deans across the country concerning environmental engineering curricula to reflect the growing importance of this line of study.

One environmental engineer monitoring developments in the field is Tom Markowitz, P.Eng., of PEO's West Toronto Chapter and current chair of its long-standing environment committee.

Markowitz, formerly of the Ontario government's environment ministry, says it's a good idea to set up an environmental committee at the chapter level. "Environmental problems (and opportunities) are becoming increasingly important at the local level, he told *Engineering Dimensions*. "The environment committee reminds chapter members to include



AN OCTOBER 2015 OSPE RESEARCH REPORT ON THE ROLE OF INNOVATION IN THE EMERGING CARBON ECONOMY ALSO SPELLED OUT SOME OF THE NEW CONSTRAINTS FACING THE PROFESSION IN TACKLING ENVIRONMENT, ENERGY AND SUSTAINABILITY-RELATED PROBLEMS.

environmental considerations in their traditional endeavours. The committee organizes seminars and site visits that broaden the environmental knowledge of chapter members."

PEO itself had an environment committee until 2006. It was disbanded when the environment came to be seen as an advocacy issue and was thus given over to OSPE.

Since retiring from the environment ministry, Markowitz remains active with chapter work and as head of EnerHope, an online education service on greenhouse gas emissions trading that also offers professional services to companies and organizations.

As an engineer with a keen interest in energy and environmental issues, Markowitz agrees there is symbolic value in adding environmental protection to the Ontario engineering act.

"This revision was absolutely essential considering the stress that our growing society is placing on the natural environment in Ontario. The application of this principle is not always easy, because some engineers and some members of the general public may not always agree on the balance between economic growth and environmental protection. Every human endeavour has environmental consequences."

ROLE OF P. ENGS IN POLICY

For its part, OSPE has weighed in on the engineering-environment link with some of its recent research papers. A study of the Ontario government's electricity generating strategy was featured in a recent Queen's Park debate as an example of how engineers can bring more evidence-based research to bear on issues of major public importance.

An October 2015 OSPE research report on the role of innovation in the emerging carbon economy also spelled out some of the new constraints facing the profession in tackling environment, energy and sustainability-related problems. "Society has granted engineers a custodial monopoly of technology through the licensing system, in exchange for imparting a regulatory and ethical duty to assess potential repercussions of climate disruption," the OSPE report reads. "As a result, engineers are depended on to use their expertise to develop solutions to combat the problem. Consequently, engineers are tasked with designing structures



and facilities in light of a 'climate future,' which is not equal to the climate past. But while the role of engineers in combatting the effects of climate disruption have typically been limited to adaptive measures, the effect of climate change on engineering practice goes well beyond the notion of adaptation, and touches on the engineer's ethical responsibility for mitigation—for being part of the global effort to reduce greenhouse gas emissions."

Individual engineers practising in the environment sector agree that the field is ripe for fresh and innovative thinking.

Sangeeta Chopra, P.Eng., is director of engineering services for the Ontario Clean Water Agency (OCWA). OCWA is an organization established in 1993 as an Ontario Crown agency committed to ensuring all Ontario communities have access to a provider of safe and reliable water and wastewater services.

Chopra, who came to her role after completing an undergraduate degree in chemical engineering, followed by a masters in civil (environmental) engineering, says it might be time to review the training and development of future environmental practitioners both by universities and by consulting engineering firms hiring new graduates.

"Environmental engineering is seen as a mix of chemical and civil, which are largely concerned with straightforward processes. Is this the same as for environmental engineers?" Chopra asks.

"To build a solid foundation as a project manager or engineer in environmental engineering,

gaining hands-on experience is key to professional development. Many consulting engineering firms encourage mentorship by teaming new graduates and junior engineers with a seasoned professional to gain such invaluable experience. At present, unfortunately, the industry is experiencing increased retirements of seasoned professionals, which limit the ability of new graduates to obtain hands-on experience from folks who have spent significant time in the profession."

She suggests a more integrated environmental engineering undergraduate program, combining chemical and civil studies, might better prepare graduates for the new environmental work challenges. "At present, environmental engineering is a specialization that sits in the civil engineering department at most universities," she says. "This division trains engineers on a broad level of physical infrastructure to meet the needs in society and focuses primarily on soils, structures, hydraulics and the design and construction of tanks, roads, etc. The environmental engineering profession, specifically water and wastewater treatment, however, includes much more than implementation of the capital/infrastructure piece. Some of this training and knowledge is gained through chemical engineering at most universities. Chemical engineers focus on research, assessments and studies, process, optimization and innovation in their program. These elements are related to improvements and can be translated to establishing the best, cost-effective solution for the public. My perception is that a more integrated environmental engineering program under both departments of civil and chemical engineering would better prepare undergraduate students for the working world."

"ENVIRONMENTAL ENGINEERS NEED TO ANSWER VERY DIFFICULT AND INTELLIGENT QUESTIONS ASKED BY THE PUBLIC, CITY COUNCILS AND POLITICIANS ON INFRASTRUCTURE SPENDING," SANGEETA CHOPRA SAYS.

However future practitioners are developed, Chopra and other present-day practitioners believe environmental specialists will only grow in importance as governments and communities struggle with climate change, severe weather, asset management, infrastructure resilience and risk assessment concerns.

"Environmental engineers need to answer very difficult and intelligent questions asked by the public, city councils and politicians on infrastructure spending," Chopra says. "There are increasing demands and limited availability. As a result, the education needs to respond by providing a holistic education that involves the ability of graduates to assess options through research and development and evaluations, which will prepare them to improve, innovate and optimize the functionality of existing infrastructure before recommending major capital investments be undertaken."

William Lubitz, PhD, P.Eng., environmental engineering leader at the University of Guelph, also sees the development of a new breed of environmental specialist as a boon for society and for the profession.

The University of Guelph was one of the first Canadian universities to establish a free-standing environmental engineering program and, in many ways, its growth and reputation have reflected the increasing importance of this sometimes misunderstood discipline.

"I think it is natural for environmental engineering to have emerged as a recognized field," Lubitz told *Engineering Dimensions*. "It is a multi-disciplinary field, and long before you could get a degree in environmental engineering, there were many mechanical, civil and chemical engineers extending their skills and knowledge to do this work. The problems environmental engineers solve are unfortunately ubiquitous and not going away anytime soon, so it is only logical for environmental engineering to have evolved as its own field of practice. It allows focused training of students and then a common framework for practitioners."

ENVIRONMENTALIST IN ALL ENGINEERS

Lubitz suggests there is a hint of the environmentalist in every professional engineer, and given the growing interconnectedness of the environment and sustainability, there will be ongoing incentive for future practitioners to come up with new approaches and innovation.

"As a P.Eng., our ultimate responsibility is to the health of the society in which we live and practise," Lubitz says. "Once you consider the ripple and follow-on effects of any engineering endeavour, it is difficult to not recognize that negative impacts on the environment will ultimately have negative impacts on people."

But if environmental engineering becomes more meaningful in light of new constraints, will it add new pressure on the profession to prepare and license practitioners? New PEO President Bob Dony, PhD, P.Eng., FEC, believes climate change and risk assessment will certainly bring opportunities for the next round of practitioners. "There is going to be a lot opportunity in that field as there is recognition of what more we need to do to deal with climate change and carbon reduction," Dony says. "As carbon reduction plans become more a part of the regulatory process, I think the expertise of environment engineers is definitely going to be in high demand."

It could also promote a greater voice for engineers at policy-making tables as communities marshal all resources for the sake of sustainability and environmental stewardship. "Calling in the expertise of the people who understand the mass balances and energy balances involved in these discussions would allow, hopefully, more evidence-based policy development," Dony adds.

Although some professional engineers and policy-makers debate the urgency of climate change and the need to make a sudden transition to a carbon economy, there appears little doubt environmental engineers are poised for a new prominence. "Engineers are the people with the knowledge about how to solve our climate change problems," says Markowitz. "Unfortunately, governments are not listening to engineers enough.

ALTHOUGH SOME PROFESSIONAL ENGINEERS AND POLICY-MAKERS DEBATE THE URGENCY OF CLIMATE CHANGE AND THE NEED TO MAKE A SUDDEN TRANSITION TO A CARBON ECONOMY, THERE APPEARS LITTLE DOUBT ENVIRONMENTAL ENGINEERS ARE POISED FOR A NEW PROMINENCE.

Simple, necessary solutions to our climate change problems are being ignored."

But to make themselves heard, practitioners now and in the future will be required to communicate their expertise and their solutions more forcefully. "This is a great area for young engineers," says David Lapp of Engineers Canada. "There is a lot of innovation and creativity required. And it's not just about engineers working within themselves, but with other professionals. This really fosters the notion that we're all in this together and we need to look at things from different angles."

It's a challenge that Engineers Canada—working with universities, provincial and territorial regulators, consulting engineers and other associations—is prepared to tackle head on. "There's added urgency to include environmental practitioners at the policy-making table, and this connects directly to opportunities for environmental engineers," says Jeanette Southwood. "The profession is up to the challenge of participating in, meeting and surmounting these issues. The question is, how do we? How do we access the opportunities? That's part of the work that Engineers Canada is doing—ensuring that engineering and engineers are involved in the dialogue concerning this issue, and in communicating that it's urgent that engineers be involved and that our voices are heard." **e**