Business and the Environment Concentration

Environmental Innovation & Entrepreneurship Program

Progress Report
Dear Friends,

Thank you for investing in the exciting work being done in the school’s Environmental Innovation and Entrepreneurship (EIE) Program and the Business and Environment Concentration. We’d like to update you on what our students and faculty have accomplished this year. Highlights include:

- An Electrical and Computer Engineering team has developed a working prototype of a portable mass spectrometry tool that detects environmental leaks in real time. The prototype is fully functional in the lab and will be field tested next summer.

- Tyrata’s IntelliTread™ has achieved an exciting milestone, field testing its products with the City of Durham. The company’s new scientific advisory board is made up entirely of Duke faculty, helping to further advance Duke’s pioneering tire tread-sensor technology for improved vehicle efficiency and safety.

- We continue to develop the Master of Environmental Management program’s Business and Environment (BE) concentration. BE students are engaged in a variety of related projects and internships, and alumni are doing well in their careers at companies like Apeel Sciences, Disney, Verra, Conagra, Kraft-Heinz, Citibank, Aptar, ERM, and Elkay.

- A group of first-year and second-year MEM students made a Career Trek to Austin, Texas, where they visited eight organizations to learn about their environmental sustainability practices.

- This summer’s Innovation & Entrepreneurship Fundamentals and Global Immersion Program hosted about 30 percent more students than it did in 2018, its first year.

We also enjoyed hosting members of the Board of Visitors in April, showcasing business-minded students who are making a significant impact on the environment.

We hope you’ll read more about our work in environmental innovation and entrepreneurship in the pages that follow. Again, thank you so much for your support.

Jesko von Windheim
Associate Dean
Gorguze-Peters Professor of Environmental Entrepreneurship & Innovation

Deborah Rigling Gallagher
Associate Dean for Professional Programs
Chair, Business and Environment Program
Professor of the Practice, Resource and Environmental Policy
Business and Environment concentration: “There’s so much interest”

Jesko and Deb continue to develop the Master of Environmental Management program’s Business and Environment (BE) concentration. The inaugural Class of 2018 comprised five graduates. There are 18 students on the Class of 2020.

BE students are engaged in a variety of highly experiential projects, internships, and independent study, and Deb reports that alumni are doing well in an assortment of private-sector sustainability-related careers.

Students in the BE concentration benefit from its integration of business and entrepreneurship classes. Students learn about environmental challenges and business skills in the classroom; engage with clients on projects that positively impact the environment; and are exposed to the startup environment at companies like Tyrata.

“Merging BE and entrepreneurship coursework allows for scalability and, because they augment each other, students get a complete education,” Jesko says. “Those who have supported the program have laid the groundwork for the BE concentration, and as the program continues to evolve and grow – and the Nicholas School looks to the future – environmental programming will become more application-oriented.”

BE students and faculty work with a wide variety of clients

In Spring 2019, BE students and faculty worked on master’s and client projects for a number of diverse organizations. “Much of this work has already led to concrete environmental improvements,” says Deb.

Master’s projects

- Two projects with Lenovo, one with Saxbys Coffee, and one with the Nicholas Institute (Deb advised)
- Two projects with Drucker + Falk, one with Cotton, Inc., and one with Duke Alumni Travels (page 17) (Jesko advised)
- Projects with EnerTech Capital and J.P. Morgan (Chris Wedding advised)
- Project with Ortec Finance (Joe Bachman advised)
- Projects with Biogen and Cree, Inc. (Jesse Daystar advised)

Client projects

- Sustainable Business Strategy – Counter Culture Coffee, Parker Ranch, Conagra Brands, Lenovo, Cree, Inc., Cabot Corporation, E-Source, and Las Vegas Sands (Deb advised)
- Marketing for Environmental Professionals – Duke Alumni Travels, DuoCotton, and 374Water (Jesko advised)
- Life Cycle Assessment – Pearl iZUMi (Jesse Daystar advised)
- Independent study – U.N. Global Compact (Deb advised)

continued on page 4
Gallagher agrees. “The programs make a great partnership because they unite different skills and experiences and help us advance entrepreneurship into a larger environmental context,” she says. “Students are increasingly interested in using entrepreneurial mindsets, skill sets, and tools to work on startups and bring new ideas to older companies.”

Both consider the ability to engage clients a cornerstone of a student’s managerial skill set.

“We believe that students who are good client managers, are already halfway to a great career,” Deb says. “That — in addition to the core environmental domain skills the BE program teaches — is what makes the program a valuable experience for our students.”

The BE advisory committee has been another boon to the program. Made up of an engaged group of about 10 mostly Nicholas School alumni from a variety of careers, the committee has been “very helpful in providing feedback and guidance for recruitment and with things like targeting students and messaging, which is important as sustainability becomes more mainstream,” Gallagher says.

“There’s so much interest in the BE concentration when I’m traveling, so we know that prospective students are out there; we just have to reach them with some of our emerging success stories.”
Board of Visitors and Alumni Council members impressed by EIE accomplishments and activities

Board of Visitors and Alumni Council members who visited the Nicholas School in April got to see firsthand how the Environmental Innovation and Entrepreneurship Program comes to life.

The group visited Tyrata to see its pioneering tire tread-sensing technology (page 6). They also attended a presentation by MEM students who conducted a market analysis of ultra-low gossypol cottonseed for Cotton Incorporated.

During the visit Deb and Jesko highlighted the Business and Environment track’s (page 3) immersive approach to engaging students in business, entrepreneurship, and the environment.

“We received terrific feedback on the BOV visit,” Jesko says. “I believe that those who have invested in entrepreneurship at the Nicholas School can feel good about the amazing impact they have had on our students and faculty.”
Tyrata, Inc. is a Durham-based tire sensor and data management company that was founded out of programs at the Nicholas School of the Environment and the Pratt School of Engineering. The company develops Duke-licensed sensor technology that measures tire tread wear in real time. Founded in 2018, the young company has made a number of exciting advances this year.

Tyrata announced in March that its patented IntelliTread™ internal real-time tread-wear sensors demonstrated repeatable results in tests of various original-equipment passenger tires. The sensors measure tread depth using a proprietary sensor and electronic technology mounted inside the tire. Tread depth can be displayed to consumers and/or transmitted wirelessly for further analysis.

In October the company announced that its IntelliTread sensors had been tested in aircraft tires and effectively measured tire-tread depth in a controlled setting. These real-time measurements will give ground crews and aircraft tire manufacturers the data they need to maintain tire health for optimal performance and safety. Tyrata will perform additional durability and field tests soon.

Also in October, Tyrata announced that its IntelliTread platform now includes a low-profile drive-over system (DOS). Developed to meet the need of fleet management, automotive service centers, and truck depots for low-cost, real-time monitoring of tread wear, the system yields actionable data when a vehicle drives over a speed bump-like unit.

Sensors in the IntelliTread Drive-Over System are linked to cloud-based data analytics to notify personnel about tread conditions. The system is now being evaluated in pilot studies, including monitoring tires for the Durham, NC bus system.

In addition to its technological advances, Tyrata also established a scientific advisory board this year. Led by Aaron Franklin, Tyrata’s chief technology officer, the board – made up of Duke faculty members – is helping to develop the company’s sensor technology and to advance all aspects of tire monitoring and data monetization.

By guiding the company’s data extraction, handling, and processing, the scientific advisory board is building on Tyrata’s robust scientific foundation to strengthen the IntelliTread sensor. Board members include:

- Steven Cummer, the William H. Younger Professor of Electrical and Computer Engineering, is an expert in wave interactions with complex materials and environments.
- Miroslav Pajic, an assistant professor of electrical and computer engineering, is deeply knowledgeable about data handling and management in the digital world of automobiles and other complex environments.
- Leslie Collins, a professor of electrical and computer engineering, is a noted authority in the rapidly growing field of machine learning. She works with large data sets to determine both technology-specific and big-picture outcomes.

Beyond the excitement of building a company, “the thrill at Tyrata is that it is also turning into a wonderful teaching vehicle for entrepreneurship – one that goes way beyond traditional educational programs,” Jesko says.

“Eight EIE certificate students did their independent study at Tyrata this semester, we have internships, and in the future there will be jobs. It’s now a fully integrated platform that perhaps can become a model for Duke University startups.”

To learn more, visit tyrata.com/news.
Summer project helping to expand sustainability-focused podcast

Second-year BE students Samantha Burch and Annabelle Mercer T’17 worked over the summer with Sustainability Defined, a popular podcast that explains, one topic at a time, the often unclear subject of environmental sustainability.

Sustainability Defined’s hosts/co-founders “identified the need for a marketing strategy that will help strengthen their positions as thought leaders in the industry and accelerate the podcast’s month-over-month growth,” Mercer says.

“Our goal was to streamline their marketing efforts and create a cohesive brand that will increase sponsorship and listener reach, and thereby expand societal knowledge of sustainability.”

To achieve this, Burch and Mercer used skills they learned in the BE program to develop a targeted marketing communications plan and helped the client begin to implement several of its strategies.

“Sustainability Defined hoped to have our ideas come to life over the summer, so we focused a lot of energy on rolling out the strategies we developed,” Mercer says. “They were excited to have the plan to streamline their marketing efforts.”

The students are thankful for the EIE funding that supported the project, as well as for the relevant skills they learned in their Marketing for Environmental Professionals class.

“It was exciting to have a chance to work with Sustainability Defined, a podcast I admire and have been following for some time,” Burch says. “The generous EIE support allowed us to apply what we’ve learned at the Nicholas School and in the BE program to a tangible, real-world project.”

Both women are confident that their BE education and experiences will be valuable in their careers.

“We’ve had amazing opportunities in the Nicholas School to work on client-based consulting projects, including through the Marketing for Environmental Professionals class,” Mercer says. “That sparked an interest in sustainability consulting for me, so I’ll be pursuing that as a next step in my career.”

Burch says the Sustainability Defined project “helped [her] develop marketing and communications strategies to educate and impact a wider audience on the pressing topic of sustainability. It was a perfect introduction into business development and strategy, the line of work I’m pursuing post-graduation.”
In October, 10 MEM students from the Nicholas School chapter of Net Impact made a Career Trek to Austin, Texas, where they visited eight diverse organizations and talked with sustainability professionals.

The group of first- and second-year BE, Water Resources Management, and Energy and Environment students visited Whole Foods, Dell, 3M, Cirrus Logic, Facebook, YETI, the City of Austin Office of Sustainability, and The Cynthia & George Mitchell Foundation. They also got to tour 3M’s Innovation Center and Cirrus Logic’s lab.

“We learned firsthand how our career paths can lead us to roles in sustainable innovation,” says Net Impact career liaison and first-year BE student Lily Wherry.

“At each company we visited, we learned how innovation and entrepreneurship can fuel the corporate sustainability movement, and our meetings demonstrated how important investing in new ideas is for sustainable change. As corporations face increased consumer and stakeholder pressure to adopt sustainable business practices, they have begun prioritizing designing new fundamental systems.”

This year’s Career Trek was organized by second-year BE student Ben McCormack. Scott O’Connell MEM’01, Dell’s director of Environmental Affairs & Global Producer Responsibility, arranged for his company to serve as one of the host organizations.

The trip was made possible with a $9,000 gift from donors Jason Karas MBA’97 and Romi Gottfrid MEM’97 and a $1,500 Innovation and Entrepreneurship Initiative grant aimed at expanding student engagement with start-up companies.

“While the trip focused on the corporate sustainability programs, we also learned about how these organizations integrate environmental

continued on page 9
entrepreneurial activities into their overall business strategies,” McCormack says. “We talked with the sustainability experts about how their companies support innovation and startup activities both within the company and in the environmental field, and we got good insight into how the startup companies achieved lasting success. Meeting companies in their own spaces helped us better understand current needs and trends in corporate sustainability.”

Career Treks benefit BE students, the organizations they visit, and nearby Nicholas School and Fuqua School of Business alumni, Gallagher says. “They’re a great way for us to do external outreach and for the students and organizations to engage with each other,” she says. “The companies are always excited and eager to work with our students.”

The trip also included an alumni social, during which students networked with Austin-area Nicholas School alumni and learned about new environmental startups and ventures.
Sophisticated ecophysiology tagging technology aims to help researchers better understand how — and how well — marine and terrestrial animals physiologically adapt to environmental conditions.

Dave Haas is a Marine Science and Conservation PhD candidate and National Science Foundation research Fellow who is working in the lab of Doug Nowacek. He is also the founder of Cetacean Research Partners.

Haas and his team received EIE summer-internship funding to continue the development of FaunaTag, a digital ecophysiology tag they began prototyping in 2017. Unlike other wildlife tags, FaunaTag is the first that the team knows of that includes a bio-optical physiology sensors package.

Also unique, Haas says, is the plan for a dual-license model, in which researchers and educators “essentially can have open access to tag hardware and software called tagOS. Those who wish to commercialize the device can convert or opt for a commercial license, which will help fund future research and development centered around the FaunaTag platform and its research objectives.”

The team made a lot of progress over the summer, coming up with “what we believe to be a pre-production FaunaTag printed circuit board that is suitable for use in both marine and — with two sensor modifications — terrestrial wildlife,” says Haas. “We’re increasingly confident that it will be ready for testing and use in marine animals in early 2020.”

Follow the team’s progress at nicholas.duke.edu/news.
Mass spectrometry — a sophisticated analytical method used to measure the mass of molecules within a sample — has countless potential commercial applications.

Three second-year Master of Environmental Management students — Andrew Brown, Benjamin Mobley and Yukun Xu — teamed up with second-year Master of Engineering Management student Shady Tarek El Bassiouny to work on building a business case for mass spec technology in Jesko’s Fall 2018 Entrepreneurial Experience class.

“I learned so much from the project because it was based on a real-life situation, using real technology,” El Bassiouny said. “I want to pursue a career in entrepreneurship, so it was an amazing learning experience to work with my team on a real project.”

Team projects for the course had students look at mass-spec technology from an entrepreneurial point of view and develop mock start-up companies. Teams were tasked with conducting market research, identifying potential markets, and creating business models and market-entry, operational, and financial plans. (Team members may execute the companies after the course is over, if they wish.)

El Bassiouny also completed a summer internship with Tyrata, where his primary responsibility was to test Tyrata’s external tire-reader technology at a customer site. Although he worked before coming to Duke, the internship was the first time El Bassiouny interacted with a customer, developed a test study, and analyzed study data for further development.

“I learned a lot on the technical side during my internship, but for me the main lesson was about the importance of being able to learn on the fly,” he said. “That’s the biggest part of working in a start-up environment and knowing what to expect when pursuing entrepreneurship as a career.”

“Working with Jesko taught me vital lessons for a career in entrepreneurship, and I will always consider him a mentor,” he said. “Both the class and the internship were important milestones, and I’m really glad I took advantage of those opportunities.”
Student marketing plan aims to raise funds for water-oxidation tech company

Jesko’s Marketing Communications course has proven valuable to Duke students outside of the Nicholas School.

While concentrating in environmental management and policy, Monisha Eadala, a second-year master’s degree student in international development policy at Duke’s Sanford School of Public Policy, took the course in Spring 2019 as part of the Environmental Innovation and Entrepreneurship Certificate program.

Monisha worked with second-year BE students Ben McCormack and Luofei Yan and Yan Gao iMEP’19 to establish a marketing plan for 374Water, a Pratt School of Engineering-based company developing supercritical water oxidation (SCWO) technology.

“This class gave me a structured path into Nicholas School coursework,” says Eadala, one of eight students in this year’s EIE Certificate program. “Because I aspire to run my own company or nonprofit in the future, I thought that getting the EIE certificate would help me reach my goals.”

The students created a detailed marketing communications plan to help the company raise funding, she says, while directly reaching out to its potential customers.

“Our interactions with the client were wonderful; the team wanted to add as much value as possible, and the client was supportive of our efforts throughout,” says Eadala, adding that she was able to use the templates from the class for other purposes at Duke.

“The course enabled me to think like a marketing person,” she says. “I’m now confident that I can take up any project and effectively present to an audience.”

Eadala says that Jesko and adjunct professor Karl von Gunten – also the marketing director of Laird Thermal Systems – “were very patient and dedicated to our project” and gave the team detailed feedback each week.

“That really helped us develop a robust marketing communications plan that has been beneficial for 374Water,” she says. “And the company has actually implemented several of our team’s suggestions.”
Participation up in year two of innovation and entrepreneurship program

Duke-Duke Kunshan University summer program draws international students

The second **Innovation & Entrepreneurship Fundamentals and Global Immersion Summer Program** went off without a hitch — and hosted more students this summer than in 2018. Twenty-eight students* took part in the July 21-August 9 program, up from 22 last summer.

The international program – a Duke-Duke Kunshan University (DKU) partnership – is aimed at undergraduates and recent graduates who wish to learn from experts more about turning ideas into businesses.

Participants spend a week at DKU in Jiangsu province, China, followed by two weeks at Duke’s Durham campus. While at Duke, students attend seminars, visit local businesses and organizations, and examine case studies with Jesko, his start-up team, and other Duke faculty.

This year’s program added two Duke faculty members as instructors: **Jeff Glass**, a professor of both Electrical and Computer Engineering and Mechanical Engineering and Materials Science, and **Paul Fearis**, a senior lecturing Fellow in the Department of Biomedical Engineering and the director of Design Insights.

*Six were from China’s (C9 League) Nanjing University, 17 were DKU undergraduates, and others were from England’s Liverpool University, as well as from Wuhan University, Nankai University, Xiamen University, and Southwest Jiangtong University – all in China.

continued on page 14
Students attended seminars that included Strategic Planning and Innovation; Creating an Innovative Organization; Principles of Product Design; Product Development; Marketing and Communications; Scaling Up Your Business; Entrepreneurship and New Business Creation; and Startup Financing and Next Steps for Entrepreneurs.

They also made site visits to Tyrata; Lenovo; Duke Innovation and Entrepreneurship Initiative; North Carolina Office of Science, Technology, and Innovation (Department of Commerce); First Flight Venture Center; North Carolina Idea; and the American Underground Entrepreneurs Tech Hub.

Participant feedback was overwhelmingly positive again this year.

“Virtually every student said that they learned a lot to prepare them for entrepreneurial careers,” said Laura Lipps, assistant director of Student Services’ Executive Education in the Nicholas School.

“This program immerses students in the mindset and global ecosystem of innovation and entrepreneurship, and we’re thrilled that they gain a whole new perspective on and framework for thinking about innovation.”
2019 has been an exciting year for Electrical and Computer Engineering assistant research professor Jason Amsden, doctoral student Kat Horvath (sidebar), and their team: they have developed prototypes of an innovative instrument that uses mass spectrometry to detect leaks of toxic compounds.

The team created three similar prototypes — each smaller than the one before it — of a portable tool used for real-time detection BTEX chemical leaks. The smallest prototype is now operational. BTEX chemicals are volatile organic compounds — benzene, toluene, ethylbenzene, and xylenes — that are byproducts of oil and gas refining.

The team is currently characterizing the performance of the latest prototype, for which nearly every piece is custom made, says Amsden.

“While there are kinks to work out, the instrument — which uses the novel technique of spatially coded apertures to reduce instrument size without compromising performance — works as designed and we’re optimistic about its potential uses,” he says.

“Jesko has been guiding the team, both in our search for additional applications of the technology and in the process of transitioning it to the commercial marketplace when it is ready,” adds Amsden.

At press time, Jesko had just received a National Science Foundation grant to — together with Jeff Glass in the Pratt School of Engineering — commercialize the miniature mass spectrometer.

**From NYC to space: What’s coming up**

There’s a lot on the horizon for Horvath, Amsden, and the team. They’re gearing up to build a prototype of a similar instrument aimed at detecting leaks of different molecules. The custom-made parts have been

*continued on page 16*
ordered and assembly will begin in early 2020.

“Our current prototype was designed to detect chemicals within a specific mass range,” Horvath says. “The new prototype is being designed with a higher mass range, which means it can detect a wider range of chemicals. The key difference in the two systems will be the magnetic sector, with the newer prototype having a much stronger magnetic field.”

Next summer, Jesko and the team will take the new prototype to New York City, where they’ll test it alongside a gas chromatograph, “the gold-standard instrument of our industry collaborator, PFT Tech,” Horvath says.

In addition, thanks to its previous work, the team received three noteworthy grants over the summer. The grants – only two of which currently can be publicized – will allow them to further develop the technology. They include:

- A three-year $925,318 grant from NASA will fund work – performed in collaboration with the University of Arizona and Goddard Space Flight Center – is aimed at developing the team’s coded aperture mass spectrometry technology for planetary exploration.

- A one-year $75,000 grant from the North Carolina Biotechnology Center will help the team to explore the current prototype’s ability to measure stable isotope ratios of carbon, nitrogen, and sulfur. Stable isotope measurements have many applications in medicine, agriculture, and forensics.

Look for updates on the team’s progress at nicholas.duke.edu/news.

Prototypes ready: Mass spectrometry for detecting environmental leaks continued

**Student profile: Kat Horvath**

In 2015 Kat Horvath moved to the Triangle to pursue a job opportunity. After earning her B.S. in nanoscale engineering from SUNY at Albany, she joined Cree, Inc. as a process sustaining engineer, developing next-generation green technologies.

Once she settled into her job and life in North Carolina, Horvath began exploring the idea of returning to graduate school. In her review of schools and programs, she discovered Jesko online and reached out to him.

“I told him I was interested in environment-oriented, tech-to-market work used for things like combating climate change, and he referred me to Jeff Glass’s group in the Pratt School of Engineering,” Horvath says. “I met the group, it was a good fit, and I started in April 2017 as a research assistant.”

As the only female in her 27-person SUNY graduating class and one of very few women at Cree, Horvath says that she sometimes has felt like an outsider.

“As a woman in a STEM field, I’ve certainly experienced a sense of not belonging at various times,” she says. “I hope these fields continue striving to create cultures of open-mindedness, to encourage more female leadership, and to promote more diversity and inclusion.”

Horvath’s advice for women in STEM careers? “It’s important to think about goal-setting, to work toward a vision, to find female role models and mentors, and to support other women in STEM fields,” she says. “I also think it’s very important for women to believe in themselves and to remember that they deserve their opportunities and positions they hold.”

Horvath’s goal is to earn her PhD in 2021.
BE students help Duke Alumni Travels promote sustainable travel

Master’s project aims to increase the use of sustainability measures and metrics

Duke Alumni Travels (DAT), an educational travel program for Duke alumni, parents, family, and friends, is working with the travel industry to help develop a framework for benchmarking the sustainability practices of its operators.

The goal is to create methods and metrics aimed at reducing the environmental impact of travel – and ultimately, for operators to serve as industry leaders in sustainable educational travel.

To that end, DAT director Beth Ray-Schroeder, T’83 enlisted second-year BE students Samantha Burch, Courtney McCorstin, and Annabelle Mercer, T’17. The women are conducting the work as part of their master’s project, “Spearheading Sustainability.” Jesko and Emily Klein are the lead faculty on the effort.

“I think our project is especially important in light of the growth the travel industry is expected to see, and I’m very excited to be working on it,” McCorstin says. “It’s about making sure that companies offering travel experiences do so in a way that’s responsible and that ensures the sustainability of destinations for years to come.”

The team is collaborating with travel operators Lindblad Expeditions, Orbridge LLC, Odysseys Unlimited, and Alumni Holidays International to highlight their environmental, economic, and sociocultural achievements and to identify shareable best practices. The team’s findings will inform its final report, which will be published on the DAT website and presented at the Educational Travel Consortium conference in February 2020.

“In the long term, Duke Alumni Travels aims to leverage the best practices of its educational travel operators to help improve sustainability standards across the industry,” Ray-Schroeder says. “This project is making headway among our tour operator and planners, as well as in how we educate our future sustainability leaders.”

Nicholas School hosted sustainable travel panel

Organized by the BE program, the “Spearheading Sustainable Travel” panel was held in October at Duke. Retired National Geographic VP for Research, Conservation and Exploration John Francis was the keynote speaker and a panelist.

“John is energized about our travel-sustainability project with the graduate students, as well as about Duke’s prospects in general,” says Ray-Schroeder. “He has taken a particular interest in the Nicholas School.”

The other panelists were Jason Karas, MEM’97, senior director of Expedia’s Global Marketing Organization; Rhea Simms, Asia-Pacific program manager with the Planeterra Foundation; and Karl Egloff, director of travel and conservation with the World Wildlife Fund. Jesko served as moderator.