

## **Creation of the Center for the Study of Contaminants of Emerging Concern**

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**Discovery Opportunity:** Contaminants of Emerging Concern (CECs) in consumer products, drinking water, treated water, soil and air pose substantial risks to human health and deleterious ecological impacts in the environment. These CECs include 1,4-Dioxane, perfluoroalkyl and polyfluoroalkyl compounds, microcystins, along with a plethora of other pesticides, herbicides, pharmaceuticals, personal care products and antibiotics. Antibiotics are detrimental in their own right, but can also result in the proliferation and transfer of resistance genes into potentially disease causing organisms. Many CECs are ubiquitous in the environment, found in landfill leachate, ground water, municipal wastewater, potable water, treated water, soil and air at levels that are potentially detrimental to humans and the environment.

Due to their suspected health risks, CECs are an urgent concern to the community, and state and federal regulators. However, the overwhelming lack of toxicological and epidemiological information, and inadequate knowledge regarding the sources, exposure pathways, and fate and transport in environmental systems has hindered our ability to assess these risks. Except for a few well-studied CECs, virtually nothing is known regarding the environmental fate of most CECs, and this problem is exacerbated by an annual influx of new CECs entering the marketplace. The ad hoc research that has been done to date to study the fate and impacts of CECs released into the environment has simply not kept up with the rapidly expanding CECs market. Directed, ongoing integrated studies are needed to study the biogeochemical fates of CECs and their socioeconomic, human health and the environmental impacts.

To meet these needs, we propose to develop a world-class center that will (1) coordinate ongoing CECs research by ESF scientists and their collaborators and provide economically-feasible solutions to CECs problems, and (2) be responsive to a changing CECs landscape. ESF is strategically positioned to head this center and become the go to institute for CECs studies. This center naturally fits into ESF's primary mission to foster research and education regarding the natural and built environment, and we have much of the needed infrastructure and core scientific expertise to form the basis for this center.

To create the Center for the Study of Contaminants of Emerging Concern, we will merge ESF's current capabilities and strengths with strategic hires and academic, governmental and industry partnerships. The long-term goal is to use this center to leverage research opportunities and build a critical mass of scientists focused on all aspects related to CECs research so that we can respond quickly to CECs of societal concern not only within New York State but throughout the US and abroad. We will not only provide the expertise and fundamental knowledge, but also provide solutions through the development of advanced treatment systems and appropriate standards to mitigate risk. The second goal of our proposed Discovery Grant is to coordinate the creation of the center with funded research and CECs proposals currently under consideration or planned for submission in the near future.

To position the Center as a world-class facility and leverage funding for CECs research, one critical function of the Center and the proposed research effort will be to obtain required certifications. As an example, through the Center we will seek approval as a National Voluntary Laboratory Accredited Program (NVLAP) laboratory. This accreditation is required in many cases for funding from DEC and other agencies.

**Undergraduate and Graduate Programs:** The creation of a Center for the Study of Emerging Contaminants is expected to impact undergraduate and graduate education in nearly all ESF departments (1) by serving as the nucleus for all CECs research conducted by ESF and its partners, and (2) by coordinating advisory or education efforts such as workshops and seminars. These activities will have positive and lasting impacts on undergraduate and graduate programs by fostering educational opportunities and promoting interdisciplinary research, and by creating a network of investigators and knowledge that will be available to all participating students. The newly created CECs Center is expected to attract students from a variety of disciplines in the STEM and social sciences, and this center will serve as an important catalyst for the creation of the Environmental Health Ph.D. academic program at ESF. The center will foster investigations that lie at the science-policy interface, and for that reason, we expect to host several interdisciplinary doctoral projects through our Environmental and Natural Resources Policy program (ENRP); these fully integrated case studies will serve as valuable instructional examples to further enrich our curricula. Because The Center's work will lay the foundation for better practices for sustainable water use, we expect to develop connections with the graduate Certificate of Advanced Study in Sustainable Enterprise (CASSE), run jointly by ESF and SU.

**Funding Entities:** The ESF Center for CECs would position ESF as a world leader in the field of CECs research, policy and education, greatly improving our visibility and ability to obtain funding from industry and the many state and federal funding agencies that are keenly interested in CECs research including EPA, NIH, DOD, NSF, NASA, the State Department, NIST, NYSEDA, DEC and DOH, all of which have extensively funded CECs research. Separately, we also plan to work closely with the College Foundation and the administration to obtain long-term foundation support from key constituencies such as the Water Research Foundation, the Kresge Foundation, the Hewlett Foundation, and the Ford Foundation.

**New and Expanding Partnerships:** One of the main goals of the proposed project is to develop and leverage strategic academic partnerships within Syracuse (SU and UMU) and beyond (e.g., Clarkson) to obtain funding from supporting state and federal agencies, and to develop or expand partnerships within the corporate sphere such as OBG, Roux or British Petroleum to not only do the necessary basic research but also to work with entities who are dealing with real-world problems caused by CECs. To this end, there are efforts by our research team currently underway on several fronts to forge these partnerships. For example: (1) Discussions are ongoing with Dr. Gina Lee-Glauser, Clarkson University, to partner our proposed Center with their proposed Center of Excellence in "Healthy Water" to enhance both institutions capabilities and expertise as a platform to leverage funding and support for CECs research and education. (2) A proposal is in preparation to develop an NSF Industry/University Cooperative Research Center (I/UCRC) centered on CECs, with partners from the University of Arizona and Arizona State University. (3) We are in discussions with NYSDEC to develop capacity in CECs research that will support the mission of the NYSDEC Finger Lakes Hub in the development of treatment systems such as that for the algal toxin, microcystin, which is currently a very pressing human health concern in NY lakes and waterways that serve as sources of drinking water.

**Use of ESF Assets:** An important focal point of the Center will be the inclusion of state of the art instrumentation and technologies that will allow us to identify, track and remediate CECs as needed for CECs-funded research by our ESF colleagues and partners. Current assets include but are not limited to liquid or gas chromatography coupled to single or dual mass spectrometry (LC-MS-MS, GC-MS), Nuclear Magnetic Resonance Spectroscopy (NMR) and scanning

electron microscopy, and a new high resolution LC-MS-MS purchased as part of the joint Environmental Health program at ESF-UMU (Upstate Medical University).

Most analytical work will be done on the main campus, but properties such as Lafayette Road offer the opportunity for the construction and operation of pilot scale test facilities for remediation technologies being developed at the Center. Jumps from bench scale to application are often plagued with complications; the room to construct and utilize pilot scale facilities will increase the successful implementation of remedial technologies. Longer-term goals are to use the Thousand Islands Biological Station and the Adirondack forest properties to study the fate and long-range atmospheric transport of CECs. Likewise, if the proposed ESF Onondaga Lake Research and Education Center is built, it would serve as the perfect site for our Center and its research and educational activities.

**Policy Decisions, ESF's Reputation and Global Impact:** Our group plans to explore the human dimensions of the policy issues surrounding CECs, drawing on frameworks from sociology, public policy, management, and more. In contrast to other environmental contaminants that are more fully characterized and regulated (e.g., mercury), this heterogeneous category of contaminants is just now appearing on the agenda of policy makers and legislators. We anticipate that regulations and policies will be forthcoming, and will take place in a piecemeal and episodic way. Understanding the contrasting ways that the problem is being defined and addressed is an important research challenge, for faculty as well as graduate students focused on the science-policy interface. The process by which the problem is defined and appears on the regulatory agenda is worthy of examination, and contrasting the dynamic regulatory frameworks, within the US as well as internationally, helps provide insight into environmental policy process. To date, members of our team have already been involved with organizations that influence policy development on these issues (e.g., Driscoll with the International Atomic Energy Agency and Moran with the American Water Works Association), and our future collaborations will build on this knowledge and expertise. Looking toward the future, the range-of-choice for policy makers turns on viable control strategies, as well as prevention options. Our research will explore ways to prevent problems, using methods including: life cycle assessments, materials substitution, backcasting, and more. Concerning the mitigation and elimination of CECs from the environment and especially water, multiple methods are essential to explore. The viability of these methods (e.g., effectiveness, cost) will undoubtedly be an area of future funded initiatives. Some approaches that will be examined include microbial and phytochemistry remediation, electron beam technology, advanced oxidation systems, and hydrodynamic cavitation oxidation.

**New Investments:** To accomplish our goals, leverage funding, and enhance our research capabilities, we will vigorously pursue strategic new instrumentation acquisitions and personnel hires. Initially, new equipment will include (1) a DNA sequencer to aid investigation into the emergence or migration of genes conferring algal toxin production or bacterial antibiotic resistance, (2) a hydrodynamic cavitation reactor used for advanced oxidation studies, and (3) a second LC-MS-MS for the expected high demand in nearly all our CECs funded research.

The research team will use the Discovery award as leverage to obtain an Empire Innovation Program grant to hire well-funded, established faculty members to conduct research related to CECs. The most pressing need is an analytical chemist dedicated to the identification and quantification of CECs and associated chemical and biological transformation products employing LC-MS-MS, and a technician to operate and oversee the day to day operation of core Center equipment including the LC-MS-MS and the DNA sequencer.

## **Center for the Study of Contaminants of Emerging Concern Feasibility Statement**

Contaminants of emerging concern (CEC) in water, soil and air pose substantial risks to human and environmental health. The U.S. currently has more than 85,000 chemicals in commerce with about 2,000 new chemicals introduced into commerce annually. Thus, CEC are an ongoing concern that will pose a threat to the environment and humans into the foreseeable future. The vast majority of these chemicals lack adequate toxicological or fate and environmental transport information to help understand their health effects on humans or environmental systems. Several institutions and centers in the U.S. conduct research on some aspects of CEC, including ESF; however, none are focused only on CEC. We propose to create a center to facilitate the study of fate and transport, human and ecosystem health effects, and advanced treatment methods for these contaminants in water, soil, and air. The Center will involve nearly every department at ESF and will serve as the hub of CEC research in the U.S. that promotes fundamental and applied research and education, and is responsive and nimble to the changing CEC landscape and the public's perception of CEC. The Center will find solutions, develop risk assessments, and create and analyze policies guided by research, with the goals to stimulate innovation, and promote and protect the environment, and human health and well-being.

Our Discovery Grant project plan is to:

1. Submit a proposal for a cluster hire to the Empire Innovation Program that would strengthen our core competency in risk assessment, soil science, microbial ecology, molecular biology, water-treatment, and CEC detection.
2. Set up the CEC Center - identify the director and core leadership team, develop a website, solicit members and partners, investigate a site to house the Center, garner appropriate lab certifications, and strategize initial funding avenues and fund mini grants to obtain preliminary data.
3. Develop targeted CEC courses for undergraduate and graduate students at ESF, and provide research opportunities to promote interdisciplinary approaches to solving local to global problems.
4. Use grant funds to leverage funding for core equipment needed for the Center including a hydrodynamic cavitation reactor, a DNA sequencer and an upgrade to or new LC/MS/MS.
5. Use ongoing research on advanced treatment methods, phytoremediation and citizen science-based monitoring to immediately leverage funding for new CEC projects.
6. Conduct a search for a post-doctoral scholar to conduct full time research on the fate, transport and degradation of CEC. This will allow the team to obtain results for the submission of large multidiscipline proposals.
7. Position ESF as the hub of CEC research and education by inviting prominent CEC researchers (and major funding program managers) to a series of theme-focused workshops on CEC research.

The Discovery Grant will provide the support needed to develop a long term self-sustained Center. Proposals will be submitted to state and federal agencies as well as private companies using the Center and its activities as leverage for funding. Nearly all federal agencies are interested in CEC including DOD, EPA, DOE, NSF, State Department and NIH. Interested state agencies include DEC, DOH and NYSERDA, while private companies include, but limited to, OBG, Roux and British Petroleum. Team members have ongoing projects on CEC with DOD, DEC, NSF and a major petrochemical company.