

PROJECT DESCRIPTION

The Institute of Environment, a preeminent program at Florida International University, located in Miami-Dade County, a HUD-designated Most Impacted and Distressed (MID) area, is applying for General Planning Support (GPS) funding to establish the Environmental Finance-Knowledge and Innovation Community (EF-KIC). This unique non-profit community, with its associated institute, and academic and executive training programs, will bring together universities, businesses, and government organizations from around the world, for the purpose of developing cutting-edge cross-disciplinary theories, data, policies, and practical know-how that foster mitigation and adaptation and increase resilience against each of the mitigation needs listed in the State of Florida Mitigation Action Plan: flooding, windstorm, sea-level rise, coastal erosion, ecosystem degradation, heat, wildfire.

Many communities in Florida are already establishing formal efforts to address resilience of biophysical, societal and economic systems in the face of evolving environmental stresses such as sea level rise and rising temperature, and shocks such as increasing strength and frequency of hurricanes, and unforeseen health disasters such as Covid-19. The frequency and magnitude of the environmental stresses and shocks will only increase both spatially and temporally, and yet the communities do not have post-disaster plans to adequately deal with enormous consequences of physical damage and more importantly, the financial implications both recover and future sustainability. While many resiliency programs across the state are focusing on the biophysical implications of hazards, to date, they have not addressed the financing aspects of resiliency equation. The resiliency profession in this environment is in the early phases of germination and we believe the professionals in this field will need adequate knowledge and training to address the physical, societal, and economic aspects of resiliency.

Society's environmental problems and their solutions are rooted in complex interactions between human and natural systems. The financial system plays a major role in this by driving human actions that induce and respond to environmental change. Consequently, a growing body of recent literature documents the importance of utilizing modern finance and capital markets to spur progress in disaster mitigation, adaptation and resilience¹.

¹ See for example: The World Bank (2015). *Finance for Climate Action; A Snapshot of the World Bank Group's Climate Action*. The World Bank, Wash. D.C., 36 pages; https://www.worldbank.org/content/dam/Worldbank/document/Climate/FinanceClimateAction_Web.pdf

Marsh & McLennan Companies (2017). *Financing for Climate Resilience*. The Marsh & McLennan Companies, Global Risk Center, 30 pages; <https://www.mmc.com/content/dam/mmc-web/Global-Risk-Center/Files/2018-climate-resilience-handbook-financing-for-climate-resilience.pdf>

United Nations Economic and Social Commission for Asia and the Pacific (2017). *Finance for Climate Action in Asia and the Pacific: A Regional Action Agenda*^[17]_{Sept} to *Access Debt Capital Markets*. United Nations, 80 pages.

This integrated knowledge of finance and the environment will improve society's ability to identify, understand, and capitalize on the root interactions that cause unfavorable change and offer effective solutions to them.

Because current academic programs in finance and environmental studies have little contact with each other, a new cross-disciplinary, multi-institutional approach is needed to produce the cross-trained professionals who will plan effective mitigation, adaptation, and resilience policies and practices. The EF-KIC will undertake the research, education, applied analyses, and professional training to harness the power of capital markets and innovative finance that is needed for resilience. Through its sophisticated training, the EF-KIC seeks transformative, rather than incremental, change that helps reorient and increase financial flows that improve sustainability and resilience. Although many efforts to provide ad-hoc and piecemeal environmental finance solutions are underway across the U.S. and overseas, the comprehensive scope of interdisciplinary research, education, and training envisioned by the EF-KIC is not, to our knowledge, currently available anywhere in the world. As an international urban university, FIU is particularly well-suited to lead on this front.

The proposed EF-KIC is conceptually similar to the European Union's Climate-KIC, (<https://www.climate-kic.org>) which is Europe's main climate innovation initiative, and its "largest public-private innovation partnership focused on climate innovation to mitigate and adapt to climate change". It is noteworthy that the EU Climate-KIC has recently added finance to its primary interests. In an article titled "Rewiring finance through climate innovation", Climate-KIC's CEO expresses the need for developing "systems-level innovation that brings baskets of solutions together for climate-compatible investment". (<https://www.climate-kic.org/opinion/rewiring-finance/>)

Like the European Climate-KIC, the proposed EF-KIC is based on the concept of a "knowledge triangle" that is formed by the collaboration of universities, business, and government.^{2 3} Thus, as businesses and government increasingly seek to adapt to and

<https://www.unescap.org/resources/finance-climate-action-asia-and-pacific-regional-action-agenda-access-debt-capital-markets>

The World Bank (2015). *Finance for Climate Action; A Snapshot of the World Bank Group's Climate Action*. The World Bank, Wash. D.C., 36 pages;
https://www.worldbank.org/content/dam/Worldbank/document/Climate/FinanceClimateAction_Web.pdf

² The knowledge triangle and KIC concept are described in:

Allinson, R., 2012. "Catalysing Innovation in the Knowledge Triangle: Practices from the EIT Knowledge and Innovation Communities; Publication for the European Institute of Innovation and Technology (EIT)". Publ. Office of the European Union.
https://eit.europa.eu/sites/default/files/EIT_publication_Final.pdf

³ As detailed in the Capacity Plan, Non Governmental Organizations, philanthropic and research foundations, will be invited to join the EF-KIC.

mitigate environmental threats, the EF-KIC will be a first-of-its-kind long-term source of cross-disciplinary knowledge, practical know-how, and human development that will provide better understanding of how the coupling of the biophysical environmental system and human systems influences the root causes of, and solutions to, resilience problems. This new knowledge and understanding should enable identification of the most effective places and methods (know-how) for finance intervention to enhance sustainability / resilience against all of the priority hazard types identified in the State of Florida Mitigation Action Plan.

The goal of the EF-KIC's proposed agenda is to develop and provide useful knowledge of environmental finance to government, businesses, academia and society. For example, the EF-KIC's work involving "ex-ante funding mechanisms" for disaster recovery, such as catastrophe bonds and parametric insurance⁴, will significantly assist planning on topics such as design and pricing of flood insurance premiums and help mitigate identified risks through insurance, best practices and other strategies.

The agenda will include developing the academic programs and curricula for new master's and doctoral degrees in Environmental Finance and Risk Management. In addition to academic degree programs, a certificate program for business and government professionals will also be developed. Additional activities of the EF-KIC research work will include developing data and other capabilities to better understand evolving disaster risks, and it will collaborate with Florida public agencies in planning, and will lead public service activities.

To help accomplish its tasks, the EF-KIC will employ a number of environment-linked financial instruments that have emerged as an effective way to harness private investment and capital markets to finance public environmental initiatives. The design and evaluation of these instruments requires knowledge of environmental sciences that is integrated with modern mathematical finance. Subjects to be covered in this program will include capital markets, insurance, and the convergence of these finance and insurance in the form of catastrophe bonds that focus on managing hurricane, flood, earthquake, extreme storm, wildfire, and pandemic risks; weather derivatives that provide hedges against adverse financial consequences due to temperature, wind, or rainfall; and parametric index insurance that is used to recover from flood, drought, and extreme storms. Additional training will include; infrastructure green bonds, resilience bonds, sustainability-linked loans; carbon markets, and environmental conservation and restoration finance including environmental impact bonds that can assist management of erosion. The foregoing courses, which provide training in innovative solutions to urgent

⁴ A catastrophe bond is a security that pays the issuer / seller when a predefined disaster occurs, such as a hurricane or earthquake. If the disaster meets specified conditions, some of the investor's money is transferred to the issuer, otherwise the investor's principal is returned plus an interest payment. In exchange for a premium payment by a purchaser, parametric insurance pays a specified amount to the purchaser of the insurance policy in the event that predefined environmental conditions / parameters occur.

problems, will be augmented by a more general course that investigates root causes of problems due to complex interactions between natural systems and the financial system.

As described in this application's Budget section, the EF-KIC products, services, and publications will be made widely available to public agencies and the general public. This will result in impactful, and otherwise unavailable, contributions to understanding root causes of, and solutions to, each of the five components in Florida's Mitigation Action Plan (MAP) strategy which seeks to:

- *Reduce risks and vulnerabilities of people in hazard-prone areas through current technology, better planning and mitigation activities;*
- *Reduce the potential impact of natural disasters on new and existing properties, infrastructures and local economies;* [SEP]
- *Promote education, outreach and research and development programs to improve the knowledge and awareness among the citizens and industry about hazards they may face and mitigation alternatives that can reduce vulnerabilities;* [SEP]
- *Strengthen communication and coordination between public agencies, citizens, non-profit organizations and businesses; and* [SEP]
- *Emphasize long-term, maximum benefits to the public.* [SEP]

The process of establishing the EF-Knowledge and Innovation Community will be led and implemented by Mario Loyola and Dr. Enrique Villamor with the assistance of a small group of FIU faculty consisting of Dr. Jayantha Obeysekera, Dr. Maria Donoso, Professor Michael Sukop and Dr. Tiffany Troxler. This faculty group will begin the EF-KIC project by assembling a core group of business leaders, government officials, and additional faculty from across the FIU campus. There are currently twenty-seven FIU faculty members who wish to participate. An Advisory / Supervisory Board will be appointed consisting of members from academia, business, and government. This board will provide advice on devising the EF-KIC research, education and training schedule. The biographies and contributions of Mr. Loyola, Dr. Obeysekera, Dr. Donoso, Dr. Sukop, Dr. Troxler and Dr. Villamor are provided below. A biographical sketch and contributions of Dr. Villamor are provided below. The biographies and anticipated contributions of additional FIU faculty who will participate in the EF-KIC are attached in an Appendix to the Capacity Plan document.

Dr. Enrique Villamor is a Professor in the Department of Mathematics and Statistics of Florida International University (FIU), Miami, FL. He received his PhD in Mathematics from Washington University in Saint Louis (1989). He conducts research in both pure mathematics and applied mathematics, more concretely in financial engineering, where he uses deep mathematical tools to design, price and hedge all kinds of security financial derivatives to manage the different kind of risks in the financial markets, including climate risk. Dr. Villamor developed and implemented the Master program in Risk

Analysis and Management (Financial Engineering) at FIU in 2006 and he has developed and taught all the financial mathematics courses in that program. In the EF-KIC project, Dr. Villamor will be the scientific director in charge of providing training, education, and research on specific environmental finance tools specifically designed to provide creative, efficient and innovative financing to all kind of mitigation, adaptation and resilience projects. These environmental finance tools include “cat” bonds, weather derivatives, green bonds, Emission Trading Systems and other applied methods of modern mathematical finance. He will also be in charge of fostering research and education to develop a framework for understanding financial and natural systems interactions and how these connections relate to effective resilience policies and practices.

The EF-KIC project will begin by assembling a core group of business leaders, government officials, and faculty from across the FIU campus. An Advisory / Supervisory Board will be appointed consisting of members from academia, business, and government. This board will provide advice on devising the EF-KIC research, education and training schedule.

The requested funds include the costs of hiring new staff, who may come from academia, business, or government. The new positions will include an Executive Director, Assistant Director/Director of Research, Secretarial/Administrative Assistants, and Post-Doctoral researchers.

From previous preliminary environmental finance work, FIU has already drawn collaborative interest from leading firms in the global financial and insurance communities, as well as from local and national government agencies that are vital to disaster planning and response. These organizations include Allianz Insurance (the world’s largest insurer), Nephila Capital (the world’s largest environmental risk investment fund), NOAA (chief economist), Miami-Dade Office of Resilience, and a Jupiter, Florida-based climate-oriented hedge fund, Voloridge Investment Management, and its climate change non-profit affiliate, the VoLo Foundation.

The anticipated outcomes of the EF-KIC include promoting effective policies and practices for disaster resilience and mitigation / adaptation by establishing a strong long-term collaboration network with local, state, national, and international financial, insurance, and environmental communities. Its work at the forefront of cross-disciplinary science and finance will add a crucial but currently missing piece to the puzzle of understanding the origin and consequences of, and efficient practical solutions to, environmental change and natural hazards.

The EF-KIC will serve as a large scale “hub” for environmental finance research, education, and training. By providing the first academic training in environmental finance the EF-KIC will build the capacity of professionals whose work assists:

- Disaster preparedness and pre-event funding for shelter, transportation, communication, hazardous material management, and other expenditures that

reduce harmful after effects from delayed response to, and recovery from, natural hazards, and which especially affect low-income and disadvantaged communities

- Financial mechanisms for creating, conserving and restoring nature-based solutions to natural hazards
- Hedging adverse weather costs for food, water, energy security
- Effectiveness of the multi-trillion-dollar Environmental, Social, Governance (ESG) investment trend that is sweeping worldwide financial markets, government agencies, and sustainability management organizations. For example, ESG assessments are now becoming part of the criteria used by bond rating agencies and investors and, thus, will affect funding decisions and borrowing costs of local, State, and Federal levels.
- A new business model to promote Florida's green finance and blue economy

The requested funding will be used to develop the EF-KIC as a multi-institutional consortium of universities, businesses, and government. The GPS funds will be eventually replaced by tuition, research grants, funds from corporate memberships and events so that the EF-KIC continues over the long-term.

Affiliated with the EF-KIC's new Environmental Finance and Risk Management master's, doctoral, and professional training programs, it will form the Environmental Finance and Risk Management (EFRM) consultancy service consisting of specific teams of faculty and students to consult for specific companies and government organizations to identify vulnerabilities and to plan out a course of action for resilience and recovery.

In addition to hiring new staff, the EF-KIC Budget also includes expenses for:

- Developing Open Access Environmental Finance courseware that will be available to the ten university members of the Florida Climate Institute
- Developing the EFRM Consultancy Service
- Developing Open Access Environmental Finance models available to public agencies in Florida and to members of the Florida Climate Institute
- Developing a Master's degree level industrial training program targeting resiliency professionals in various local, regional, and Statewide agencies
- A stipend for Environmental Finance and Risk Management graduate students whose final semester internship is spent at a public agency in Florida, or an agency of the U.S. Government

- Environmental Finance training seminars for professional managers from business and government
- Environmental Finance research reports and other publications available to the general public
- An annual Environmental Finance and Risk Management conference held in conjunction with the Southeast Florida Regional Climate Change Compact.

In sum, the EF-KIC will develop and deliver first-of-its-kind knowledge and know-how devoted to innovative financial modeling, and methods for disaster preparedness, risk transfer, mitigation, adaptation, and resilience.

VALUE TO COMMUNITY

Government officials and policymakers at all levels acknowledge that the amount of funding needed for responding to environmental change and threats is beyond that which can be raised locally and must, therefore, involve the capital markets. (Please see Project Description footnote 1 for examples of literature on the need for environmental finance.) This funding need exists for pre-disaster mitigation projects as well as post-disaster recovery. However, money, alone, is not the answer. Effective resilience policies and practices, during normal circumstances and during extreme events, rely upon leading-edge knowledge of environmental sciences and modern finance and, especially, how these systems interact. Knowledge of one system or the other, by itself, is not likely to be able to provide sufficient guidance about the impacts of human actions that can induce and respond to changes in natural systems. For example, the impact of funding “green” actions may be negated by financial flows for other “business-as-usual” activities. Thus, understanding how these flows can drive complex interactions with environmental systems is necessary for planning long-term resilience. Despite this cross-disciplinary need, academic environmental and finance programs currently have little contact with each other, and no integrated, comprehensive cross-training in these disciplines is offered by any university. The EF-KIC will remedy this by developing systems-based understanding and know-how that results from connecting a body of knowledge about the natural environment, to a body of practice in modern finance.

Derivatives are the building blocks of modern financial markets and provide a means for managing the risks of investing or lending to businesses and governments. Thus, knowledge of derivatives is crucial to understanding the interactions of the financial and natural systems, and for raising and allocating capital for investment in mitigation, adaptation, and resilience projects⁵. The uses of derivatives also include providing funds for recovering from catastrophic events. For example, after being struck by Hurricane Dorian in 2019, the Bahamas received \$100 million in financing for humanitarian and reconstruction purposes from a Catastrophe Deferred Drawdown Option (a type of derivative-based loan).

The EF-KIC will establish the world’s first academic program that covers environment-linked derivatives and other environmental finance instruments and techniques. The EF-KIC will provide training, education, and research on specific proven environmental finance tools including catastrophe bonds (“cat” bonds), weather derivatives, green bonds and other applied methods of modern mathematical finance. It will also undertake broader research and education to develop a framework for understanding financial and natural systems interactions and how these connections relate to effective resilience

⁵ For more information, see Lannoo, K. and A. Thomadakis (2020), “*Derivatives in Sustainable Finance*”, CEPS-ECMI Study, Centre for European Policy Studies. <https://www.isda.org/a/KOmTE/Derivatives-in-Sustainable-Finance.pdf>

policies and practices. This combination of knowledge and skill will significantly help resilience planning at the local, regional, and Statewide levels, as well as beyond.

The training and applications to be developed by the EF-KIC will have special relevance throughout Florida where local and State officials now face difficult decisions regarding how to fund future hazard mitigation and resilience projects. For instance, catastrophe bonds, for which no educational program now exists, are an innovative example of how modern markets link environmental sciences and mathematical finance. Cat bonds help sellers / issuers obtain pre-event funding for disaster preparedness. Conversely, cat bonds attract investors because they are portfolio diversification tools that are uncorrelated with other markets. Worldwide, the cat bond market has seen aggregate issuance by business, sovereign governments, and NGOs, of more \$100 Billion. In 2014, to support hurricane preparedness, Florida Citizens Property Insurance Corporation issued the world's largest cat bond, totaling \$1.5 Billion. Last year, to support the National Flood Insurance Program, FEMA issued its first catastrophe bonds and raised \$800 million.

As a cutting-edge network at the forefront of today's most pressing issues, the Environmental Finance-KIC will have immense local, regional, Statewide and international importance. The "collective knowledge" of the EF-KIC's member network will serve as the foundation for the creation of new knowledge and know-how for addressing environmental hazards and risks. The EF-KIC focus on environment-linked financial securities and practices, along with mitigation decision tools such as Dynamic Adaptive Policy Pathways, that deal with the non-linearity and uncertainty that characterize the effects of climate change and sea-level rise, will transform Florida into the world's premier center for environmental risk management.

The Florida Mitigation Action Plan's five priority risks are flooding, tropical cyclones, severe storms, wildfire, and coastal erosion. These risks have spurred innovative risk transfer and management techniques involving environment-linked securities such as catastrophe bonds (e.g. covering flood, hurricanes, wildfire) and parametric index insurance (e.g. covering excess rainfall), and environmental impact bonds (nature-based solutions to coastal erosion)⁶. The design and evaluation of these financial techniques requires integrated knowledge of environmental sciences and modern mathematical finance that the EF-KIC will provide for the first time. Thus, the EF-KIC's work will be fundamentally helpful in attracting new funds for preparedness, recovery, and infrastructure mitigation based on environmental and operational performance impacts. Low income and other disadvantaged communities with limited financial resources face

⁶ Deutz, A., Kellett, J. and R. Zoltani (2018). *Innovative Finance for Resilient Coasts and Communities; a briefing paper prepared by The Nature Conservancy and the United Nations Development Programme for Environment and Climate Change Canada*. 15 pages. <https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/innovative-finance-for-resilient-coasts-and-communities.html>

special difficulties in recovering from natural disasters. Parametric insurance, cat bonds, green bonds, are new and evolving environmental finance innovations that help provide resources needed to alleviate the “poverty trap” effects of natural disasters.

Lifelines Served

Natural disasters are a worldwide problem that need not occur locally in order to affect Florida communities and lifelines. Disaster effects can be transmitted by way of causing population shifts and migration, as well as shocks to supply, demand, and prices for Florida’s lifeline services and products. Thus, the EF-KIC’s unique research and education, which will promote the design of new financial innovations and build professional capacity in the use of existing instruments, will aid disaster management planning locally, Statewide, Nationwide, and globally⁷.

A broad systemic viewpoint, that links environment and finance, is needed for planning effective resilience policies and practices. For example, the debt to revenue ratio of government is recognized as a source of social vulnerability to natural disasters and, in the case of Puerto Rico, debt levels affected its vulnerability to Hurricane Maria in 2017.

Pre-event and other innovative financing methods can help supply resources needed for responding to each of the Florida Mitigation Action Plan’s lifelines:

- Safety and Security
- Food, Water, Shelter
- Health and Medical
- Energy
- Communications
- Transportation
- Hazardous Materials Management

Another example of the revolutionary contribution that the EF-KIC can make involves weather derivatives training. Through the FIU-FPL Solar Research Center, led by Dr. Arif Sarwat, FIU is the primary renewable energy research partner of Florida Power and Light, which is owned by North America’s largest producer of solar and wind energy, NextEra Energy. FPL and NextEra use standard financial derivatives to hedge volatile costs of energy production, transmission, and purchasing. Furthermore, FPL has described the usefulness of financial innovations such as wind derivatives (a weather derivative that hedges volatile wind conditions). The EF-KIC research and education

⁷ For further information, please see: Venton, C.C., et al (2019). “*The Use of Innovative Financing for Responses to Refugee Crises*”. DAI Europe Ltd. & Parhelion Underwriting. 32 Pages.

<https://www.rescue.org/sites/default/files/document/3888/innovativefinancingforresponsestorefugeecrises.pdf>

would cover the design and pricing of standard derivatives and would be the first program in the world that is dedicated to training the users of weather derivatives

The EF-KIC will form the "EFRM Consultancy Service", consisting of specific teams of faculty and students to consult for specific companies to identify vulnerabilities and to plan out a course of action for resilience and recovery. This would be a direct impact on the community, while providing hands-on training for students. Over time, the group can build expertise in consulting for all seven of the lifeline areas identified in the Florida Mitigation Action Plan.

Public notice and involvement in the EF-KIC will be achieved through the liaison with the FIU communications office, and through the creation of a new dedicated EF-KIC website, periodic internet podcasts with experts from academia, business, government, etc, and a quarterly newsletter. The public can attend periodic EF-KIC outreach training sessions, such as the short, yearly non-technical EFRM foundation course, and the annual meeting, and also participate through organizations that are members of the EF-KIC, including the resilience offices of local government, agencies of the U.S. Government such as FEMA and the National Weather Service, business trade associations such as the Weather Risk Management Association, and through non-profit and Non Governmental Organizations such as The Nature Conservancy, the World Wildlife Fund, the Everglades Foundation, the Southeast Florida Climate Change Compact, the CLEO Institute, and the United Nations (e.g. the UNESCO Chair on Sustainable Water Security).

CAPACITY PLAN

The overriding goal of the EF-KIC project is create the world's premier source of academic knowledge and professional know-how devoted to developing the underlying theories and applications of environmental systems –financial system interaction. finance used for environmental risk management. The strategy and stakeholders are united through the plan to assemble multi-disciplinary university faculty and experts from business, government and NGOs. knowledge triangle combine research education design and implementation of environmental finance

Foundation of modern finance through mathematics of financial derivatives and tied to environmental systems through market innovations that improve disaster preparedness, mitigation, and adaptation such as weather derivatives and hurricane / earthquake / flood / pandemic catastrophe bonds.

Florida International University has excellent capacity to carry out the highly visible collaborative activities and services of the world's first EF-KIC. FIU's student enrollment is the fourth largest in the Nation. The Institute of the Environment, which will oversee the formation of the EF-KIC, is one of the FIU's Preeminent Programs and is home to cross-cutting interdisciplinary environmental, urban, and social initiatives of direct relevance to hazard mitigation and resilience. Other centers, institutes and schools at FIU that will participate in the EF-KIC include the International Hurricane Research Center, the UNESCO Chair on Sustainable Water Security, the Extreme Events Institute, the College of Arts, Sciences, and Education, the School of Environment, Arts, and Society, the College of Engineering and Computing, College of Law, College of Business, College of Public Health and Society, and School of International and Public Affairs. The National Hurricane Center and the U.S. National Weather Service of the National Oceanic and Atmospheric Administration (NOAA), located on the FIU campus, will be invited to join.

FIU, through the work of the Laboratory for Insurance, Economic, and Financial Research at the International Hurricane Research Center, led the multi-university project that developed and manages the Florida Public Hurricane Loss Model. The IHRC team and this model, which is used by the State of Florida to evaluate hazard insurance prices, add important strength to FIU's capacity to complete the EF-KIC project.

Another example of the revolutionary contribution that the EF-KIC can make involves weather derivatives training. Through the FIU-FPL Solar Research Center, led by Dr. Arif Sarwat, FIU is the primary renewable energy research partner of Florida Power and Light, which is owned by North America's largest producer of solar and wind energy, NextEra Energy. FPL and NextEra use standard financial derivatives to hedge volatile costs of energy production, transmission, and purchasing. Furthermore, FPL has described the usefulness of financial innovations such as wind derivatives (a weather derivative that hedges volatile wind conditions). The EF-KIC research and education would cover the design and pricing of standard derivatives and would be the first program in the world that is dedicated to training the users of weather derivatives.

In addition to resources on the FIU campus, the EF-KIC will invite the membership / participation of other universities, business and governmental organizations including, but not limited to, the Florida Climate Institute, the Southeast Florida Climate Change Compact, the Florida Department of Environmental Protection Water Management Districts, and the Weather Risk Management Association trade group.

The EF-KIC will also invite that participation of Non Governmental Organizations (NGOs) with experience or interest in environmental finance. Some examples of these NGOs include the United Nations, the World Bank, the Caribbean Catastrophe Risk Insurance Facility, the Nature Conservancy, the World Wildlife Fund, the Everglades Foundation, and the CLEO Institute

A primary purpose of Florida's Mitigation Action Plan is to *“enable decision-makers to characterize and identify the root causes of priority issue areas and to create effective solutions”*.

From this guidance, the EF-KIC will divide its focus between:

- 1) assisting decision-makers in understanding root causes and complex interactions - which is necessary for long-term solutions, and
- 2) creating effective (but perhaps short-term) solutions (to urgent priorities).

From previous preliminary work on this idea, FIU has already drawn collaborative interest from leading firms in the global financial and insurance communities, as well as from local and national government agencies that are vital to disaster planning and response. These organizations include Allianz insurance (the world's largest insurer), Nephila Capital (the world's largest environmental risk investment fund), NOAA (chief economist), Miami-Dade Office of Resilience, and a Jupiter, Florida-based climate-oriented hedge fund, Voloridge Investment Management, and its climate change non-profit arm, VoLo Foundation. EF-KIC envisions campus-wide (State-wide?) participation from faculty across FIU's (Florida's?) many programs in natural science, social science, engineering, law and other professional programs.

The EF-KIC key tasks and deliverables include:

- Research and education on the short-term and long-term issues of environmental finance and disaster mitigation / adaptation, including the creation and operation of new master's and doctoral academic degree programs in Environmental Finance and Risk Management
- Consulting and advisory services guided by research and education that is of value to government and businesses and which, otherwise, is not currently available

- Professional Training programs for business and government
- Research publications; technical reports; consulting and project assignments; EF-KIC memberships; committee appointments
- Number of student applications, training, graduation / completion, employment;
- New products, services, businesses launched; supported; designed
- Media exposure
- EF-KIC Revenue
- Member revenue attributable to EF-KIC membership
- Public leaders and stakeholders will participate / stay informed through EF-KIC's outreach to business, government, and academia such as through the ten university members of the Florida Climate Institute, the Southeast Florida Climate Compact, the Florida Department of Environmental Protection and its Water Management Districts, and the local and State resilience offices throughout the State of Florida,
- The annual EF-KIC Conference; number of attendees
- Social media followers

Quality control, monitoring, and maintenance of the EF-KIC work plan will be overseen by FIU's preeminent program The Institute of Environment's administration that already has in place similar processes for many other projects they run through the Institute.

Appendix

Additional Biographies and Contributions of Participating FIU Faculty

Dr. Giri Narasimhan, with a PhD in Computer Science from the University of Wisconsin Madison in 1989, is now a professor in the school of Computing and Information Sciences. He has expertise in Data Science, Machine Learning and Algorithms, and in applying informatics tools and techniques to interdisciplinary problems. With over 150 publications, books, and a patent in machine learning, his research has been applied to problems from the life sciences, biomedical research, public health, finance, urban planning, molecular structures, forensics, systems performance, and logical inference. His work has been funded by the National Science Foundation, National Institutes of Health, National Institute of Justice, Florida Department of Health, Department of Defense, and private industry. He is the Director of the Academy for CS Education, an industry-funded entity dedicated to outreach and professional development training of K-12 teachers and the workforce. He is also the coordinator of the interdisciplinary Master's degree program in Data Science, with specialization tracks from four different colleges. His experience and expertise in outreach, curriculum development, research in data-driven decision making, management of big data, and consulting on data analytics for resilience and planning will be a valuable asset to the Environmental Finance-Knowledge and Innovation Community (EF-KIC) and the proposed activities.

Dr. Arif Sarwat is the Associate Professor in the Department of Electrical and Computer Engineering and the Director of the FPL-FIU Solar Research Facility at FIU. His research interests include sustainable energy, high penetration renewable systems, smart grids, plug-in hybrid, and electric vehicles, storage, and battery management systems, grid resiliency, large-scale data analysis, artificial intelligence, advanced metering infrastructure, smart city infrastructure, and cybersecurity. He has published over 130+ articles. He currently has eleven funded projects from different agencies including the NSF Career Award (2016). He is an associate editor of the journal ACM Computing Surveys. He was the author/co-author of a publication that won the best paper award at the Resilience Week in 2017 and a technical article that won both the best paper award in 2016 as well as the most cited paper award in 2018 from Springer's Journal of Modern Power Systems and Clean Energy (MPCE). Dr. Sarwat received the Faculty Award for Excellence in Research & Creative Activities in 2016, College of Engineering & Computing Worlds Ahead Performance in 2016, and FIU TOP Scholar Award in 2015 and in 2019. He has worked at Siemens for more than nine years, winning three recognition awards. He has been the chair of the IEEE Miami Section VT and Communication since 2012. For this project, Arif will be responsible for leading substantial energy research and policy-making. Additionally, he will contribute to the reports and publications available to the public. In particular, he is responsible for findings and recommendations for energy and water-saving measures, including but not limited to, solar panels and power cogeneration, natural gas power, etc.

The implementation of innovative sustainable energy and energy policy will be carried out by a 3-person team- Dr. Imtiaz Parvez, Golam Md. Dastgir and Juan Sanfiel. Dr. Imtiaz is working as a postdoctoral associate in the power and energy sector for 1.5 years and has a Ph.D. in Electrical Engineering. He has 7+ years of research experience in the areas of energy and power, communication, and cybersecurity; Golam Md. Dastgir is a Ph.D. student and research assistant for conducting research in the area of power and energy; Juan Sanfiel is an MS student and research assistant, working for an efficient and sustainable nexus of food, water, and energy.

Dr. Shimon Wdowinski is a professor at the department of Earth and Environment, Florida International University (FIU), Miami, FL. He received Ph.D. in Geophysics (1990) and M.S. in Engineering Sciences (1987) from Harvard University. Dr. Wdowinski's research interests include the general areas of natural hazards, tectonics, wetland hydrology, climate change, and sea level rise. He successfully applied space-based observations and advanced methodologies for monitoring the hazards and obtaining better understand of their causes. His research has been supported by the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA). Dr. Wdowinski will contribute in establishing the Environmental Finance-Knowledge and Innovation Community (EF-KIC) by promoting education, outreach and research programs. More specifically, he will collaborate with the team's economists on translating the natural hazards into economic risk in order to develop economic and financial options for reducing the potential impact of natural disasters on properties, infrastructures and local economies.

Dr. Pallab Mozumder is a Professor (with a joint appointment in the Dept. of Earth & Environment and the Dept. of Economics) at Florida International University (FIU), Miami, FL. He has received his PhD in Environmental and Natural Resources Economics from the University of New Mexico (2005). Dr. Mozumder blends environmental economics, policy and management tools in interdisciplinary contexts to understand the vulnerability associated with climate change, extreme weather events and livelihood insecurity. A coherent theme of his research focuses on designing optimal policy responses to mitigate these vulnerabilities. The contribution of his research has been recognized by major funding agencies in the USA such as National Science Foundation (NSF), National Oceanic and Atmospheric Administration (NOAA), Department of Energy (DOE) etc. He has been nominated as one of the Next Generation of Hazard and Disaster Research Fellows by the National Science Foundation. He will contribute in establishing the Environmental Finance-Knowledge and Innovation Community (EF-KIC) by promoting education, outreach and research programs. More specifically, he will focus on developing economic and financial options for reducing the potential impact of natural disasters on properties, infrastructures and local economies.

Dr. Tiffany Troxler is an Associate Research Professor in the Southeast Environmental Research Center and serves as Director of Science of the Sea Level Solutions Center in

the Institute of Environment at Florida International University. Dr. Troxler is an ecologist whose work cuts across science, policy and management of natural and urban environments. In the field, she and her students examine the effects of saltwater inundation on Everglades coastal wetlands, monitor how Everglades ecosystems respond to efforts to restore the Everglades, and advance science to inform interdisciplinary nature-based solutions in urban environments. She's authored over 50 publications, served as co-editor and contributing author on two Intergovernmental Panel on Climate Change reports that guide national greenhouse gas inventories, co-authored a National Academies report on Negative Emissions Technologies, and co-edited the recent "A Blue Carbon Primer: The State of Coastal Wetland Carbon Science, Practice and Policy". She serves on the Miami-Dade County Local Mitigation Strategy Steering Committee and is a Certified Floodplain Manager. She has also convened or contributed to 100's of events throughout Southeast Florida to increase awareness of and promote science-based solutions that build resilience to sea-level rise and other climate change impacts.

Professor Michael Sukop is a registered professional geologist, a certified hydrogeologist, and a Fellow of the Geological Society of America. He is part of the leadership team of the Sea Level Solutions Center and a member of the Earth and Environment department at Florida International University. Dr. Sukop conducts research on a broad range of topics from computational fluid dynamics to the organization of science teams and governmental actors. He works extensively in groundwater and saltwater intrusion modeling in coastal settings and particularly on the linkages between flooding and groundwater levels as influenced by tides, surges, and long-term sea level rise. He is closely engaged with senior resiliency and public works officials throughout Southeast Florida. His contributions to the Environmental Finance-Knowledge and Innovation Community (EF-KIC) will include physical and institutional settings of at-risk communities, and physical and chemical impacts of tides, surges, and long-term sea level rise.

Dr. Jayantha Obeysekera is a Research Professor and the Director of Sea Level Solutions Center (SLSC) in the Institute of Environment at Florida International University (FIU). Dr. Obeysekera holds a bachelor's degree in Civil Engineering from University of Sri Lanka, M. Eng. from University of Roorkee, India, and a Ph.D. in Civil Engineering from Colorado State University with specialization in water resources. He is an expert in water resources modeling, engineering designs, risk analysis, planning, and management including adaptation to sea level rise and climate change. Dr. Obeysekera served as a member of the federal advisory committee which directed the development of the National Climate Assessment in 2014. He was also a co-author of the sea level rise projections report published by NOAA for the National Climate Assessment and served as a member of the Coastal Assessment Regional Scenario Working Group associated with the Department of Defense in the United States. In South Florida, he chaired the expert group that developed the 2019 Unified Sea Level Rise Projections for the Southeast Regional Climate Compact. He has served on four committees of the National Academy of Sciences to review sustainable water resources investigations in states of

Oregon, California, and Texas. Dr. Obeysekera has published over 55 research articles in numerous peer-reviewed journals. Dr. Obeysekera is a recipient of the 2015 Norman Medal of the American Society of Civil Engineers. For this project, he will contribute research input on climate change implications on both urban and natural systems, outreach, stakeholder engagement, treatment of uncertainties, and the development of resilient strategies.

Professor José Gabilondo (A.B. Harvard; J.D. University of California (Berkeley) teaches banking law, corporate finance, and tax at Florida International University, where he also serves as associate dean for accreditation. He has worked in financial market regulation at the U.S. Securities and Exchange Commission, the Office of the Comptroller of the Currency, U.S. Department of the Treasury, and the World Bank. He is the author of *Bank Funding, Liquidity and Regulatory Capital* and *Corporate Finance: Debt, Equity, and Derivative Markets and their Intermediaries*. His research focuses on financial intermediaries and their funding practices. He will advise the EF-KIC on educational initiatives regarding banking and capital markets.

Dr. Maria C. Donoso is the Director of International Programs at the Institute of Environment and the UNESCO Chair on Sustainable Water Security. Dr. Donoso pursued graduate studies at the People's Friendship University (Moscow, Russia) and the University of Miami (Miami, USA). She also holds a *Doctor Honoris Causa* degree from the Universidad Federico Villarreal (Lima, Peru). Her research and professional expertise are in water security, integrated water resources management, and social and natural impacts on water resources. Dr. Donoso is a world recognized expert in developing and implementing international multidisciplinary programs and projects. As Director of the Global Water for Sustainability Program, Dr. Donoso oversaw the execution of an over 80 million USD portfolio of development projects in Africa, Asia, The Caucasus and, Latin America and the Caribbean. Over the years, Dr. Donoso has worked with the Interamerican Development Bank. Furthermore, Ms. Donoso was a member of the World Bank Global Environmental Facility (GEF) Overall Performance Study International Team of Experts. Dr. Donoso will play an important part in the planning, establishment, and subsequent development, of the Environmental Finance-Knowledge and Innovation Community (EF-KIC) initiative, by bringing in her international expertise to expand and diversify the education, outreach and research portfolio. In many instances, she will serve as liaison between the members of EF-KIC and international partners, and provide guidance to them on innovations and trends observed in the global arena related to the drivers of complex interactions of communities/society with environmental systems to support develop policies and practices to attain long-term resilience, in particular as it relates to water security. In this context she will contribute to the development of a framework for understanding, societal, financial and natural systems interactions and how these connections relate to effective resilience policies and practices.

Dr. Cem Karayalcin is a Professor and the chair of the Department of Economics at Florida International University (FIU), Miami, FL. He has received his PhD in Economics from Columbia University (1989). He works in the areas of international and development economics, with special emphasis on the application of political economy in developing policy tools in interdisciplinary contexts. Three seemingly unrelated but nevertheless connected themes run through his research. One theme, which is couched in terms of the open economy macroeconomics literature, investigates the across-country distributions of wealth and income in a world where capital flows take a global aspect. In this set of papers, he explores the consequences of various policies in redistributing wealth internationally as reflected in financial and current accounts. A second theme, this time using the framework provided by development economics, looks at different aspects of globalization as reflected in the political economy of debt and the impact of the use of developmental tools in a context with economies of scale. Finally, a third theme is to be found in a set of papers looking at the historically divergent growth and development experiences of different regions of the globe and highlighting some of the political economy mechanisms that might account for this divergence. He has consulted with the World Bank in a number of different projects. He has also written about the political economy reasons behind the disaster policy choices for the United Nations. He will contribute in establishing the Environmental Finance-Knowledge and Innovation Community (EF-KIC) by promoting education, outreach and research programs. Specifically, he will focus on the choice of governmental policies in response to natural disasters.

Dr. Joel Barber is an Associate Professor at Florida International University, Miami, FL. He received a Ph.D. in finance from the University of Arizona, M.B.A. from the University of Texas, B.S. in Electrical Engineering from the University of Michigan, and the CFA designation. He is a past president of the CFA society in Miami. His research areas are portfolio management and derivative securities. He is interested in how financial instruments can be used to protect the environment and mitigate the financial risks associated with climate change. He will contribute to the Environmental Finance-Knowledge and Innovation Community by providing education, outreach, and research programs.