



FLORIDA A&M UNIVERSITY

# ENERGY WATER FOOD NEXUS

INTERNATIONAL SUMMIT

March 26 - 28, 2015

Tallahassee, Florida







# Thank You from Dr. Ibeanusi

Developing countries and rural communities do not have access to clean energy, safe drinking water, and food security. Without access to these needs, the global economy is in jeopardy. The EnergyWaterFoodNexus, a new science enterprise, was conceived to facilitate the convergence and collaboration of industry innovators focused on generating sustainable solutions in the energy, water, and food sectors to grow and meet the needs of the global economy. With over 500 attendees, representing participants from Botswana, the European Commission, Greece, Hungary, India, Nigeria, South Africa, and Tanzania, the EnergyWaterFoodNexus International Summit at Florida Agricultural and Mechanical University has begun the process of building the relationships for practical solutions that advance renewable energy, increase access to safe drinking water, and promoting natural resource conservation.



Additionally, the summit is promoting cross-cutting discussion, scholarship, and collaboration among researchers, students, and entrepreneurs that advance science, policy, and decision-making. Most importantly, this summit and others that will take place creates a platform for global discussions that allow participants to present innovative ideas for sustainable solutions.

I thank all the participants and with a special recognition to the key-note speakers:

**Dimitri Corpakis**, Head of Unit, Research and Innovation, European Commission.

**Istvan Kenyeres**, CEO and Co-Founder, Biopolus Institute, Hungary.

**Charles Fishman**, Best Selling Author of "The Big Thirst: The Secret Life and Turbulent Future of Water," the bestselling book on water issues in America in the past 25 years.

**Will Allen**, Farmer, Founder, and CEO of Growing Power, Inc. Will Allen is an urban farmer who is transforming the production of healthy foods for underserved urban populations.

**Andre H. Sayles**, Ph.D., Principal Deputy Director of the Office of Economic Impact and Diversity, U.S. Department of Energy

**Peder Maarbjerg**, Assistant Director for External Coordination, U.S. Department of Energy-ARPA-E

**Larry Robinson**, Ph.D., Distinguished Professor, School of the Environment, FAMU

**Dean Minardi**, CFO, Bing Energy, and

**Phyllis Newhouse**, President and CEO, Xtreme Solutions

This summit would not have been possible without the generous contributions of our sponsors: U.S. Department of Energy-ARPA-E, City of Tallahassee, AXIOM Corporation, Nexus IS Inc., Yum Brands Inc., Clean Energy Technology Center, Salter Mitchell, EarthSteps, Shell, Independent Green Technology, Southern Alliance, and Rashell Robinson.

Sincerely,

Victor Madu Ibeanusi, Ph.D.

Summit Chair

Dean School of the Environment

Florida A&M University

Tallahassee, FL 32307



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# Summit Agenda

THURSDAY - MARCH 26, 2015		
<b>5:30 P.M. - 7:30 P.M.</b>	<p>Pre-summit Welcome Reception:            Dr. Charles Weatherford,            Associate Vice President for Research            Special Guest: Charles Fishman</p>	<p><b>Venue:</b>            Clean Energy Technology Center,            3954 W. Pensacola St.,            Tallahassee, FL 32304</p>
<b>Friday, March 27, 2015</b>	<b>Summit</b>	<p><b>Venue:</b> Alfred Lawson Jr. Multipurpose Center            1800 Wahnish Way,            Florida A&amp;M University            Tallahassee, FL 32307</p>
<b>7:30 A.M.</b>	On-site Breakfast/Registration	<b>Venue:</b> Multipurpose Center
<b>8:30 A.M.</b>	<p><b>Welcome Remarks Speakers:</b></p> <ul style="list-style-type: none"> <li>• Summit Overview: Summit Chair: Victor Ibeanusi, Dean, School of the Environment, FAMU</li> <li>• John Baker, Energy Policy and Environmental Resources, City of Tallahassee</li> <li>• Andrew Gillum, Mayor of Tallahassee</li> <li>• Marcella David, Provost and Vice President for Academic Affairs, FAMU</li> <li>• Elmira Mangum, President, FAMU</li> </ul>	<b>Venue:</b> Multipurpose Center
<b>9:00 A.M.</b>	<p><b>Keynote Speaker: Bestselling author Charles Fishman,</b>  <i>The Big Thirst: The Secret Life and Turbulent Future of Water</i>            Introduction by Heidi Otway, Salter Mitchell</p>	<b>Venue:</b> Multipurpose Center
<b>9:30 A.M.</b>	<p><b>Plenary Session 1:</b>            Opening the EnergyWaterFoodNexus Dialogue            Speakers:</p> <ul style="list-style-type: none"> <li>• Peder Maarbjerg, Assistant Director for External Coordination, ARPA-E</li> <li>• Charles Fishman, Bestselling Author</li> <li>• Dimitri Corpakis, Head of Unit, Research and Innovation, European Commission</li> <li>• Istvan Kenyeres, CEO and Co-Founder, Biopolus, Hungary</li> <li>• Larry Robinson, Distinguished Professor School of the Environment, FAMU</li> </ul> <p><b>Moderator: Phyllis Newhouse, President and CEO, Xtreme Solutions, Atlanta, Georgia</b></p>	<b>Venue:</b> Multipurpose Center
<b>10:40 A.M.</b>	Session Overview: Abena Ojetayo, Chief Sustainability Officer, FAMU	<b>Venue:</b> Multipurpose Center



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<b>9:30 A.M. - 5:00 P.M.</b>	On-going Poster Session and Tech Expo			<b>Venue:</b> Multipurpose Center
<b>10:35 A.M.</b>	<b>Break</b>			
<b>10:45 A.M.</b>	<b>Concurrent Sessions 1</b>	<b>Science Enterprise</b>	<b>Accelerated Innovation</b>	<b>Science Based Policy &amp; Decision Making</b>
		<p>New Frontiers in Renewable Energy</p> <p>This session will focus on the potential utilization of sustainable storage strategies for efficient renewable energy systems</p> <p><b>Venue: Room 415</b></p>	<p>New Developments in Energy Law, Policy, and Practice</p> <p>This session explores new directions in energy law, policy, and practice, including the connection between aquaculture and energy; the regulation of renewable energy within and outside the United States; and law and policy challenges in promoting sustainable water and wastewater treatment technologies.</p> <p><b>Venue: Room 419</b></p>	<p>Building Sustainable Communities Through New Land Use Policies.</p> <p>This session will highlight effective land-use planning and how it leads to opportunities for communities to create compact, mixed-use districts that better address nexus issues.</p> <p><b>Venue: Room 449</b></p>
Session Chair		Mark Weatherspoon, FAMU-FSU College of Engineering	Randall Abate, College of Law, FAMU	Adam Jacobs, City of Tallahassee
Panelist 1		Larry Morris, Jr., FAMU-FSU College of Engineering	Keith Rizzardi, St. Thomas Law School, Miami	Michael Duncan, Florida State University
Panelist 2		Venroy Watson, FAMU-FSU College of Engineering	Jeffery Ray, Esq., The Ray Law Firm, PLLC	Will Butler, Florida State University
Panelist 3		Annadanesh Shellikeri, FAMU-FSU College of Engineering	Damilola Olawuyi, Executive Director, Institute for Oil, Gas, Energy, Environment, and Sustainable Development, Nigeria	Dan Donovan, Tallahassee, Leon County Planning Department
Session Moderator		Mark Weatherspoon, FAMU-FSU College of Engineering	Ralph DeMeo, Esq., Hopping, Green & Sams	John Baker, City of Tallahassee

# Summit Agenda

10:45 A.M.	Concurrent Sessions 2	Science Enterprise	Accelerated Innovation	Science Based Policy & Decision Making
		<p>Meeting The Global Water Challenge</p> <p>This session will focus on strategies for improving water quality and increased access to safe drinking water, including processes that generate biofuels from waste products.</p> <p><b>Venue: Room 416</b></p>	<p>Sustainable Communities</p> <p>This session will address accelerated innovations in the context of the built environment.</p> <p><b>Venue: Room 420</b></p>	<p>Every Drop Counts</p> <p>This session will examine the integration of science and public policy in the areas of agriculture and water management.</p> <p><b>Venue: Room 450</b></p>
Session Chair		Odemari Mbuya, College of Agriculture and Food Sciences, FAMU	Elizabeth Lewis, School of Architecture, FAMU	Nathaniel Bailey, College of Agriculture and Food Sciences, FAMU
Panelist 1		James Jones, Director, Florida Climate Institute	Elizabeth Lewis, School of Architecture, FAMU	Bill Bartnick, Florida Department of Agriculture and Consumer Services
Panelist 2		James Katende, Botswana International University of Science and Technology, Botswana	John Motloch, Co-director, Sustainable Communities Institute	Y. Ping Hsieh, College of Agriculture and Food Sciences, FAMU
Panelist 3		Oghenekome Onokpise, College of Agriculture and Food Sciences, FAMU		Rick Copeland, Florida Department of Environmental Protection
Session Moderator		Odemari Mbuya, College of Agriculture and Food Sciences, FAMU	Olivier Chamel, School of Architecture and Engineering Technology, FAMU	Nathaniel Bailey, College of Agriculture and Food Sciences, FAMU



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10:45 A.M.	Concurrent Sessions 3	Science Enterprise	Accelerated Innovation	Science Based Policy & Decision Making
		<p>Emerging Trends in Water Research</p> <p>This session will cover processes in wave technology, safe water distribution systems, and wastewater treatment in the context of energy production and improved water quality will be discussed.</p> <p><b>Venue: Room 416</b></p>	<p>Climate Smart Agriculture</p> <p>This session will focus on social, economical, and sustainable development goals to meet challenges of providing sustainable livelihood to farmers, food security, and eradication of poverty.</p> <p><b>Venue: Room 416</b></p>	<p>Zero Hunger: Ideas for Feeding the World</p> <p>This session will explore efforts to eliminate hunger on a local and global scale through sustainable agricultural development.</p> <p><b>Venue: Room 416</b></p>
Session Chair		Clayton Clark, FAMU-FSU College of Engineering	Richard Gragg, School of the Environment, FAMU	Sharmini Pitter, College of Science and Technology, FAMU
Panelist 1		Dan Osborne, School of the Environment, FAMU	Bharat Patel, National Council for Climate Change, Sustainable Development and Public Leadership	Bakari McClendon, Tallahassee Food Network
Panelist 2		Jennifer Cherrier, School of the Environment, FAMU	Kirit Shelat, National Council for Climate Change, Sustainable Development and Public Leadership, India	Sanjay Deshmukh, National Council for Climate Change, Sustainable Development and Public Leadership
Panelist 3		Jorge Olaves, Director of Aquatics, FAMU	Dot Inman-Johnson, City Manager, Midway, FL	Jennifer Taylor, FAMU Extension
Session Moderator		Clayton Clark, FAMU-FSU College of Engineering	Cynthia Harris, Institute of Public Health, FAMU	Harriett Paul, College of Agriculture and Food Sciences, FAMU
<b>12:00 P.M.</b>	<b>Lunch</b>			
<b>12:30 P.M.</b>	<p><b>Keynote: Will Allen, Farmer, Founder, and CEO of Growing Power Inc.</b> Introduction by Cristin Burns, New Leaf Market Co-op</p>			<b>Venue:</b> Multipurpose Center
	<p><b>Plenary Session 2: Emerging EnergyWaterFood Nexus Trends</b> Speakers:</p> <ul style="list-style-type: none"> <li>• Will Allen</li> <li>• Dean Minardi, CFO, Bing Energy</li> <li>• Bridgette Bell, Senior Manager of Global Sustainability, Yum! Brands, Inc</li> <li>• Phyllis Newhouse, President and CEO, Xtreme Solutions</li> </ul> <p><b>Moderator: Istvan Kenyeres, CEO and Co-Founder, Biopolus, Hungary</b></p>			<b>Venue:</b> Multipurpose Center
<b>2:00 P.M.</b>	<b>Break</b>			

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2:15 P.M.	Concurrent Sessions 4	Science Enterprise	Accelerated Innovation	Science Based Policy & Decision Making
		<p>Technology Applications</p> <p>This session will examine biofuel production, advances in Gulf coast research, and opportunities for water utilities and water conservation to reduce emissions.</p> <p><b>Venue: Room 415</b></p>	<p>Sustainable Corporate Strategies</p> <p>This session will present examples of private sector strategies for sustainability in food industries, and the socioeconomic impact of business decisions.</p> <p><b>Venue: Room 416</b></p>	<p>Agricultural Solutions</p> <p>This session will focus on interdisciplinary approaches to meet the social, economic and environmental challenges of food production.</p> <p><b>Venue: Room 420</b></p>
Session Chair		Ashvini Chauhan, School of the Environment, FAMU	Keith Bowers, Regional Director, Small Business Development Center	Oghenekome Onokpise, College of Agriculture and Food Sciences, FAMU
Panelist 1		John Ericsson, CEO, AlgaStar	Bridgette Bell, Senior Manager of Global Sustainability, Yum! Brands, Inc.	Kenneth Boote, University of Florida
Panelist 2		Ashvini Chauhan, School of the Environment, FAMU	LaQuinda Brewington, Mosaic	Camilo Gaitan, Florida Department of Agriculture and Consumer Services
Panelist 3		Rachel Young, American Council for an Energy-Efficient Economy	Cristin Burns, Project and Marketing Manager, New Leaf Market Co-op	Glyen Holmes II, College of Agriculture and Food Sciences, FAMU
Session Moderator		Charles Jagoe, School of the Environment, FAMU	Keith Bowers, Regional Director, Small Business Development Center	Oghenekome Onokpise, College of Agriculture and Food Sciences, FAMU



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<b>3:15 P.M.</b>	<b>Break - Venue:</b> Multipurpose Center		
<b>3:30 P.M.</b>	<b>IDEA HACKS SESSION</b>		
<b>Organizer: Latanya White</b>			
Education	FAMU Deans: College of Science and Technology	College of Engineering	College of Agriculture and Food Sciences
	College of Pharmacy and Pharmaceutical Sciences	School of Journalism and Graphic Communication	School of Architecture and Engineering Technology
	Tawainga Katsvairo, BUC Technologies, LLC		
Policy and Cultural Implications	Cynthia Hewitt, Morehouse College		
Energy	Bing Energy, Clean Energy Technology Center, Earth Steps		
Food Focus	Sharmini Pitter, College of Science and Technology, FAMU; and Mary Russ, Whole Foods		
Entrepreneurship	Latanya White, School of Business and Industry, FAMU		
Water Focus	Clayton Clark, FAMU-FSU College of Engineering/FSU		
Knowledge Multiplier Hub	Kirit Shelat, India's National Council for Climate Change, Sustainable Development and Public Leadership		
<b>4:30 P.M.</b>	<b>CLOSING RECEPTION - Venue:</b> Multipurpose Center Entertainment by FAMU Jazz Combo; Moderators: Valencia Matthews, Dean of College of Social Sciences, Arts, and Humanities; and Anne Kimbrough, Dean, School of Journalism and Graphic Communication, FAMU		
<b>5:00 P.M.</b>	Idea Hack Report: Latanya White, School of Business and Industry, FAMU		
<b>5:10 P.M.</b>	Keynote: Deputy Director Andre Sayles, Department of Energy Headquarters, Office of Economic Impact and Diversity		
<b>6:30 P.M.</b>	Closing Remarks: Victor Ibeanusi		
<b>Saturday, March 28, 8:00 A.M. - 2:00 P.M.</b>			
<b>POST-SUMMIT EVENT: ECO TOURS - WAKULLA SPRINGS</b>			

# ABSTRACTS







# ABSTRACTS

## An Economic Evaluation of Nitrate in Groundwater: A Contingent Valuation Survey in Northwest, Florida.

Lyttle-N'Guessan\*, C. J., M. H. Thomas and C. Gardner

A double-bounded dichotomous choice contingent valuation survey was administered to 2,000 residents of Franklin and Gulf Counties, Florida, with the objective of documenting any bias as a result of the institutional basis in the hypothetical payment vehicle. The mean willingness to pay (WTP) estimates for state and private payment vehicles are \$4.39 and \$5.08 per month respectively, significantly different at the 0.15 level. This is evidence of the importance in choosing the institutional foundation for the payment vehicle. The major determinants of WTP appear to be education, perception of existing water quality and the attitudes of respondents towards the environment. However, WTP responses may vary temporally and spatially with differences in demographics and goods and services valued. This may have implication for contingent valuation practitioners.

## Low Cost High Power Lithium Iron Phosphate (LFP, LiFePO<sub>4</sub>) Battery.

Olivier Barbier, A. Shellikeri, M. Weatherspoon and J.P. Zheng

LiFePO<sub>4</sub> has gained popularity in recent times & increasingly being used as one of the cathode materials [1] in LFP batteries, due to its environmentally benign nature & most importantly because of its thermal stability [2] at higher discharge rates. But, the LiFePO<sub>4</sub> battery fabrication process currently suffers from high costs & complexity due to the use of wet slurry method requiring extra safety measures due to its use of potentially harmful chemicals. A cost effective and safer

battery fabrication method is a necessity for its mass production for applications in transportation & portables.

We are presently working on developing a method of electrode fabrication and dry-room assembly for the battery, which is safer and reduces its production costs. The potential cost savings will be achieved through the elimination of material, lower capital equipment expenses, and energy and manufacturing costs. This elimination of energy expenditures and elimination of harmful solvents from the battery production process will also reduce its environmental impact.

## A Walk with Ions: NMR Studies of Energy Storage Devices

Annadanesh Shellikeri, I. Hung, Z. Gan and J.P. Zheng

The demand for advanced energy storage devices has been growing with every passing day and it has become a socio-economic priority. As one of the solutions to global energy needs, a novel energy storage device 'lithium-ion capacitor' has been developed<sup>1</sup> based on the Li-intercalation graphite & double-layer concepts, achieving much higher specific energy (82 Wh Kg<sup>-1</sup>), which makes it an ideal candidate for electric vehicle (EV) applications. However, there is a need to understand the various electrochemical processes occurring inside the sandwich structure of the capacitor at various stages of cycling. Understanding the formation mechanism of the passivation layer of solid electrolyte interface (SEI), lithium metal usage over multiple cycles, the nature of lithium insertion/ extraction in the graphite structure and other processes is a necessity. In-Situ Nuclear magnetic Resonance (NMR) technique has become a popular and an effective tool in studying the



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energy storage devices like batteries and supercapacitors due to its non-destructive nature<sup>2</sup>.

Here we present our work implemented at NHMFL, Tallahassee, where we have successfully applied this technique in monitoring of the electrochemical activities in the energy storage devices in real time, enabling us to not only identify various electrochemical processes but also to delineate the contribution of individual electrodes. This effort will certainly help improve the energy storage device design by aiding in the investigation of the structure and dynamics of the processes occurring in these devices.

## An Assessment of Residential Homeowners' Perceptions and Adherence to Local Fertilizer Ordinances and Support of Proposed Ordinance Changes. Thasya K. Campbell

Non-point source pollution is a major contributor to the declining health of surface waters in the United States. A key initiative of water pollution management by municipalities nationwide is the effective control of storm water runoff and non-point source pollution from the residential sector. The Chesapeake Bay watershed has experienced extensive transition from agricultural to residential land use, and is thus suffering from deteriorating water quality from excessive fertilizer use and input of nutrients and sediments. To mitigate impaired water quality requires effective policies and management approaches that will reduce the quantity of pollutants discharged into waterbodies. Hence, growing numbers of municipalities and state governments have adopted, or are considering the adoption of fertilizer ordinances to effectively manage non-point source pollution and storm water runoff from urban and

residential areas.

Fertilizer ordinances are a type of environmental policies which influence the use, cost and application of fertilizers and pesticides to residential or private lawns, or facilities such as golf courses. Using a mixed survey approach, this study is designed to assess the knowledge, perceptions and adherence of a stratified sample of residents in the Chesapeake, Tidewater and Virginia Beach areas to local fertilizer ordinances, and their willingness to support proposed environmental regulations that seek to address the declining water quality in the Chesapeake Bay watershed. These ordinances play a role in the development of water pollution policies and initiatives aimed at controlling non-point source pollution from residential areas. However, policies to address this issue remain underexplored in the literature, and this gap highlights the need for jurisdictions to consider and incorporate the opinions and concerns of homeowners in their efforts to develop successful water pollution control plans.

The Chesapeake Bay is inundated by urban runoff containing nutrients and sediments which contributes to the impaired water quality of the Bay. Residential areas are major culprits of non-point source pollution due to large quantities of storm water runoff emanating from paved surfaces, open land spaces, drainage systems, and rooftops. In addition, high concentrations of fertilizers, pesticides and other chemicals resulting from lawn and garden activities further exacerbate the already beleaguered state of the Bay. An assessment by the Virginia Department of Environmental Quality reported that discharge rates of nitrogen, phosphorus and sediments in 2013 from the state of Virginia totaled 60.9 million pounds, 7.7 million pounds and 3.6 trillion pounds

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respectively.

A study of this nature will provide information about the level of involvement that urban citizens can adopt, in conjunction with federal, state and local efforts to improve water quality, and the direction of future decision making processes, and environmental policies and programs. The results of this study will provide insight about current challenges, as well as potential setbacks to change and future issues. As landscapes continue to transition toward residential land use and fertilizer usage intensifies, it is imperative that water pollution plans integrate specific guidelines and program incentives to increase adherence by homeowners, so as to reverse the degraded quality of waterbodies in the Chesapeake Bay watershed.

## Indoor Farming is the Future

Logan Chappell

Indoor farming is moving an outdoor farm inside of a multi level building. It is a solution to water and energy usage, as well as food production. Due to control of the environment inside the building, the indoor farm uses 1% of the water sprinklers would use on a traditional farm (Shigeharu,1) This is a dramatic decrease in water usage and impact on the environment. The building could collect rainfall to lower the water costs.

The LED lights are low energy consuming lights, with a long lifespan, and can emit specific colors of the light spectrum beneficial to plant growth. Although, with so many of them, they are the majority of energy costs associated with indoor farming. Solar panels mounted on top and around the building would assist the electricity expenses. The amount of gas used to transport

food would decrease.

As the world's population expands at an exponential rate, the demand for food will increase. Without insects, these farms have no need for harmful and carcinogenic pesticides, while producing organic fruits and vegetables. No longer would unpredictable weather effect production. I need more room to explain how beneficial indoor farming could be.

## Cost Analysis for Energy Storage System

Vincent Mtenga, L. Morris Jr., M. H. Weatherspoon

Due to the rising cost and limited availability of fossil fuels, society as a whole is moving away from pure consumable energy resources to reusable/regenerative and supportable/sustainable infrastructures. Energy usage data from the National Renewable Energy Laboratory's System Advisor Model (SAM) will be used to model the same size housing structure in the Pacific Northwestern and in the Southeastern United States geographical areas for this study. Modeling of each house equipped with the same size solar cell array will be considered to determine the benefits of equipping the houses with a battery energy storage system (BESS) over a simulated period of 12 months. Some cost factors that are needed to determine the best long-term price benefits solution for a consumer will be done using MATLAB and COMSOL. These applications will be used to develop comparative matrices based on load demand; peak shaving considerations, component cost, electricity cost, and cycle rate over a 3-year versus 10-year period with an overall goal is to minimize cost and maximize consumer usage time.



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## Development and Modeling of Organic Based Lithium-Oxygen Batteries

Ruben Nelson, Mark H. Weatherspoon

Lithium-oxygen (Li-O<sub>2</sub>) batteries are an attractive technology due to its high theoretical energy density and environmentally friendly attributes. In this overview, the impact of their potential use in specific industries, such as the automobile industry, and the current progress of the technology is discussed. Furthermore, a fabricated and characterized Li-O<sub>2</sub> cell is presented that contribute to the current research available. Galvanostatic cycling and electrochemical impedance spectroscopy (EIS) results show that Li-O<sub>2</sub> cells are limited to low current charging and discharging due to reaction kinetics and diffusion limitations. Despite this, the experimental discharge capacities achieved are above 1 Ah, normalized to the electrode catalyst deposit mass, or approximately 400-500 mAh, normalized to the entire electrode mass. The resulting EIS spectra shows large growth in internal impedance that hinders its long term cyclability. Ultimately, an improved Li-O<sub>2</sub> battery should be capable of cycling over one hundred times while maintaining limited impedance spectra growth.

## Analysis of Size and Impact of Storage on Grid Connected Photovoltaic Systems

Richard Aarons, Omonayo Bolufawi, Mark H. Weatherspoon

Power systems are becoming more decentralized as the penetrations of renewable energy sources, including photovoltaics (PV), increase. This increase in local generation promotes local consumption of energy

leading to reduced transmission losses. Draw backs to local PV grid connected systems include reduced grid stability, weather dependence and often times a mismatch between power generation and load requirements. The integration of battery storage with renewable energy systems can mitigate some of these problems. Battery storage is however very expensive and the cost of storage generally depends on the application. For off grid systems the main purpose of storage is autonomy while for on grid systems the main reason varies from peak shaving to reducing fluctuations in power supplied to the grid.

In this work we examine the use of battery storage systems for economic reasons, to reduce the cost of electricity purchased from the grid while minimizing the size of the storage needed. This is done by theoretically determining the optimal storage size for grid connected PV systems. This work also demonstrates the effects of storage on a PV system by simulating PV systems with storage that implement peak shaving and comparing the results to similar systems without storage.

## Changes in the Molecular Composition of a Gulf of Mexico Crude Oils resulting from Microbial Biodegradation

Gregory M. Hitz

The ability of microbes to biodegrade crude oil in marine systems is well known. However, research opportunities exist to provide a more detailed chemical characterization of crude oil fractions before or after bacterial degradation. A pilot project was designed to understand in more detail how *Paeruginosa* alters the molecular composition of crude oil as it utilizes the carbon as an energy source (biodegradation).





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A light, sweet crude oil, similar to Deepwater Horizon crude, will be the carbon energy source for *P.aeruginosa*. The crude oil will be placed in various microcosms with *P.aeruginosa* and incubated over a 20-day period. Pre- and Post-treatment crude oil samples will be characterized using an ultra-high resolution of a Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) to determine the complex molecular compositional changes occurring in crude oil from microbial degradation. Comparison of pre-treatment and the various post-treatment crude oil samples will show changes in the molecular composition of the crude oil from *P.aeruginosa* biodegradation with and without sunlight inputs. This pilot study will serve as a precursor to a dissertation research project that investigates in more detail the changes in molecular composition of various types of Gulf of Mexico crude oils (light sweet, medium, and heavy sour) under biodegradation from various in situ microbial communities present in the Gulf of Mexico.

## Feasibility Study for the Use of Glycerol as a Substitute for Hydrogen in Iron-Ion/Hydrogen Redox Flow Cell

James Akraji, Yaw Yeboah and Egwu Eric Kalu

The effect of a growing biodiesel market has led to an increase in the production of glycerol – the main by-product – resulting in the generation of huge surplus of the commodity. With the consequence of a decrease in the commercial value of glycerol and the whole biodiesel chain, it has become imperative to advance endeavors aimed at exploiting glycerol for high value end products.

The electrochemical oxidation of glycerol has been studied and known to be a source of several chemicals of premium industrial value. The process has been utilized in the concept of direct glycerol fuel cells to produce electrical energy additionally. In the current study however, this concept is extended to cover both electrochemical oxidation and reduction of glycerol as a substitute for the hydrogen ion in the application to a redox flow battery with a  $Fe^{2+}/Fe^{3+}$  couple as cathode. Given the known mechanism for the electrochemical oxidation of glycerol, this study will highlight on the electrochemical reduction of glycerol as a means of charging the flow battery and a further source of value added chemicals as determined by characterization techniques.

## Assessment of Pesticidal Bioactivity and Repellent Potency of Selected Tanzania Indigenous Mushroom Species in Stored Maize Grains.

Nelson E. Masota

*Sitophilus zeamais* is highly infestant to maize grains, a staple food in Tanzania. The use of modern pesticides by subsistence farmers is facing affordability and human toxicity concerns. Moreover many mushroom species of medicinal value are available in Tanzania. This study aimed at assessment of bioactivity and repellency profiles of selected mushroom species against *S.zeamais*.

Six levels of concentrations of crude extracts in absolute ethanol from 6 mushroom species were established. Three replicates made for each and used to treat 40 maize grains in containers. Actellic gold dust 2% and absolute ethanol were used as controls. Counting of dead insects was conducted for 21 days.

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Cantharellus cibarius killed 58.5% of insects in 14 days after treatment compared to 100% kill 3 days after treatment by Actellic gold dust 2%. Reproduction inhibition rate was 100%, a decrease in grain damage of 46.7% and percentage repellence of 100%.

This study demonstrated a potential bioactivity of C.cibarius against S.zeamais. This can be a substitute to the commercially available pesticides to subsistence farmers as well as a source of novel Pesticidal compounds.

## Synthesis and Characterization of LiMnPO<sub>4</sub> Batteries for Sustainable Energy Systems

Charles F. Oladimeji, Pedro L Moss, Mark H. Weatherspoon

In this paper we demonstrate an efficient and cost effective method to produce LiMnPO<sub>4</sub> for use in sustainable energy systems. LiMnPO<sub>4</sub> has an olivine structure with operating voltage of 4.1V and theoretical energy density of 170mAh/g. LiMnPO<sub>4</sub> has many drawbacks such as low electronic conductivity, large volumetric change, Jahn-Teller distortion etc. Particle size reduction, coating, and doping have been reported as ways of improving the performance of the battery.

We propose developing performance enhancement methods to help bring LiMnPO<sub>4</sub> closer to commercialization. Synthesis of LiMnPO<sub>4</sub> from NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub>, Li<sub>2</sub>CO<sub>3</sub>, MnCO<sub>3</sub> and sucrose were prepared using solid state reaction method. After carbon coating, the prepared LiMnPO<sub>4</sub> were characterized using Scanning Electron Microscopy (SEM), X-ray diffraction (XRD) and electrochemical measurements. XRD revealed very good crystal structures with peak position and peak intensities similar to standard LiMnPO<sub>4</sub> material on the JCPDS

database. Charge/ discharge test performed exhibited very low capacities at low rate. Enhancement methods prescribed improve the capacities and also the high rate performance of the battery.

## Electrochemical Generation of Energy and Chemicals from Glycerol Using CuNiMoP

Oyidia Elendu, Yaw Yeboah and Egwu Eric Kalu

The production of biodiesel from vegetable oils and fats has led to an increase in the quantity of available glycerol - a useful by-product of the process. Biodiesel is consistently more expensive than petroleum derived diesel, and biodiesel pump price may be reduced if value is recovered from the produced glycerol. Using principles from electrochemistry, energy and valuable chemicals can be co-generated from the electro-oxidation of glycerol. In this work, CuNiMoP electrocatalyst for glycerol oxidation has been synthesized using electroless deposition technique. The effect of bath composition and time of deposition on the morphology and electrocatalytic activity of the CuNiMoP catalyst were studied. The electrocatalyst was then used as the anode material in the oxidization of glycerol in alkaline medium. Results will be presented on the feasibility of co-generation of energy and fine chemicals using synthesized CuNiMoP electrocatalyst. The product distributions for the direct glycerol fuel cell will also be discussed.





# ABSTRACTS

## The Genome of *Rhodococcus opacus* strain M213

Ashish Pathak

The genome of *Rhodococcus opacus* strain M213, isolated from a fuel-oil contaminated soil, was sequenced, assembled and annotated which revealed a total genome length of 9,194,165 bp encoding 8680 putative genes, and a G+C content of 66.72%. Among the protein coding genes, 71.77% occurred as COGs (clusters of orthologous groups of proteins), and 55% of the protein coding COGs were present as paralog clusters. Furthermore, 22.5% and 20.7% of protein coding genes were connected to KEGG and MetaCyc pathways, indicating the presence of a cohort of genes that likely form new enzyme/other bioactive compounds in strain M213. Pulsed field gel electrophoresis (PFGE) analysis on strain M213 revealed the presence of three different sized replicons, which included a chromosome, a 750Kb megaplasmid (pNUO1), and a smaller, approximately, 350Kb megaplasmid (pNUO2). In addition whole genome optical mapping revealed six distinct replicons, including the presence of two megaplasmids- a circular, ~1.2 Mb plasmid, and a linear, ~0.7 Mb plasmid, along with a chromosome that mapped into 4 pieces of 2.7, 2.2, 1.3 and 0.7 Mb (total optical map size ~7 Mb total). Genome-wide comparative analysis with 43 whole genome sequences of other rhodococci showed that strain M213 did not have a high level of synteny with other taxonomic relatives including *R. opacus* strain B4 and *R. opacus* strain PD630; rather strain M213 aligned more closely at the functional level with the catabolically versatile *Rhodococcus wratislaviensis* strain IFP 2016, *R. imtechensis*

RKJ300, *Rhodococcus* sp. JVH1, *Rhodococcus* sp. DK17 and *R. jostii* RHA1, as revealed by a hierarchical clustering of orthologous groups of proteins (COGs) analysis. An in-depth genome-wide comparison between the functional relatives of strain M213 led to the identification of 1361 unique genes, representing 16% of the genome of strain M213; many of these genes possessed catabolic functions. Moreover, as many as 154 genomic islands, many with catabolic genes, particularly for PAHs biodegradation, were found within the genome of strain M213 that were likely acquired via relatively recent lateral gene transfer. Of major interest was the identification of several GEI-encoded genes that most likely participate in degrading naphthalene (NAP) via a previously undescribed pathway in strain M213. Moreover, some of the NAP degradative genes were found to be duplicated within the genome of strain M213; a strong indication for several distinct genes for NAP degradation originating via reshuffling of genetic modules and genomic rearrangements in strain M213. The identification of clustered regularly interspaced short palindromic repeat [CRISPR] genes and as many as 154 genomic islands (GEIs) further provided clues on the genome plasticity of this soil isolate, brought about by alteration in the strain's genome by horizontal gene transfers (HGT), bacteriophage attacks, and genetic reshuffling during its evolutionary trajectory. In addition, several catabolic oxidoreductases, dioxygenases and hydrolases were GI-encoded in M213 suggesting their recruitment via acquisition, loss, and evolution of catabolic genes on which little is currently known. Overall, we show that diverse genetic and metabolic traits possessed by strain M213 such as the cohort of plasmid-borne biodegradative genes, likely enhances its



# ABSTRACTS



ecological fitness in a complex soil habitat where survival is mainly via exploitation of toxic hydrocarbons.

## Series/Parallel Reconfigurable Battery Packs with Cell Balancing Technology

L. Morris Jr., M. H. Weatherspoon, J. F. Stephens, and P. L. Moss

This paper proposes a series-connected reconfigurable multi-cell design with a novel parallel charger for charge equalization. Reconfigurable battery packs have the advantage of altering the pack topology to adapt to changes in load requirements. The series/parallel battery configuration allows a low cost solution for networks under constraint to meet the energy and power demand placed on an electrical system without adding additional batteries and incurring additional cost. The DC-DC fast charging parallel converter allows the network to balance each cell and accurately estimate the battery state of charge (SOC). The proposed design is evaluated using MATLAB Simulink to simulate a 3-battery switching topology which is capable of performing charging equalization, battery isolation, battery bypass, and series/parallel configurations to meet multiple load demands. Incorporation of an aggressive charging algorithm enabled MATLAB to take advantage of the parallel DC-DC converter characteristics, allowing for the optimization of the battery pack while increasing the charging efficiencies.

## Electrochemically Modulated Extraction of Neodymium

Shannon Anderson, Egwu E. Kalu and Mikael Nilsson

Nuclear energy is becoming a viable alternative energy source with its high efficiency and reduced greenhouse gas emission. However, the process generates lanthanide/actinide-containing, radioactive waste, which if left unprocessed can lead to future storage issues. Separating these materials would reduce the amount of radioactive material that is put in the repository. The separation of lanthanides and actinides using the liquid-liquid extraction technique poses a major challenge due to the chemical similarities of the two groups of metals. Hence, interest exists in devising a technique to improve the separation factor. The use of an imposed external field (electrochemical) to improve the liquid-liquid extraction has been explored in the literature with limited success due to conductivity issues. In this work, the use of reverse micelle solutions containing water/AOT-HDEH-P/n-dodecane for improved electrical conductivity will be explored. The distribution ratio of Nd in an electrochemically modulated liquid-liquid extraction containing reverse micelles will also be presented. The results of a feasibility study of electrochemical modulation of neodymium (Nd) extraction using the reverse micelles/microemulsions will be presented and its mechanism discussed.



# ABSTRACTS

## Utilizing the Particle Filter Method to Estimate SOC and SOH of a Pseudo-2D Reformative Battery Cell

J. Bruno, L. Morris Jr., M. H. Weatherspoon, P. Moss

Battery management systems employing filtering techniques to determine different battery states (i.e. state of charge (SOC), state of health (SOH), and remaining useful life (RUL)) are very common. The Kalman filter (KF), a linear quadratic estimation method, has been used almost exclusively in linear equivalent circuit modeling (ECM) to estimate battery states. Batteries, however, are non-linear objects and cannot be fully evaluated continuously using linear methods. Particle filter (PF) is an algorithm based on a non-linear recursive Monte Carlo technique of estimating the posterior density of the state variable given a set of observation variables. COMSOL software will be used to emulate a non-linear pseudo two-dimensional (2D) reformative battery. MATLAB then will be used to analyze the COMSOL data and simulate a PF to estimate with higher accuracy the different battery states. A real-world system developed using Arduino/MATLAB will be compared to the simulated COMSOL/MATLAB data to determine the effectiveness of the Pseudo-2D model derived from using the PF method.

## Community Owned Bio-Sand Filtration Systems

Viv Pitter

Our project addresses the growing problem of communities in developing countries lacking access to safe drinking water, by implementing our design of an economical water filtration unit. The unit is a bio-sand filter, or BSF, a treatment process that uses a biological

community that develops in the top layer of sand for removal of suspended particles and microbial organisms. We built our first in-field filter in Munyiginya in the Rwamagana District of Rwanda. The filtration system is primarily applicable to rural communities using contaminated surface water, which is one of the primary reasons we selected Munyiginya for the pilot location. By taking advantage of the bio-sand filtration technology, we were able to create a system that effectively reduces biological contamination in surface water by 99.999999% and arsenic tested by 70-80%, as shown through our research at USC, while only using local materials. Once constructed, the filtration unit can be entirely community owned and operated. Customers would pay a minimal price for water, which would employ someone to operate and clean the unit, as well as create a savings fund for any future repairs or maintenance.

## Does Climate Variability Affect the Financial Sustainability of Farmers in Northern Florida? A Causality Analysis

Kimberly Marie, Daniel Solís, Michael Thomas and Sergio Alvarez

The purpose of this research is to present a framework to analyze if there is any statistical correlation between climate variability and commodity prices in Northern Florida, and whether real causality effect exists. This assessment is significant because it aids to strengthen North Floridian farmers' awareness as well as preparing them for possible fluctuations in their commodities' by analyzing the correlation between the El Nino Southern Oscillation (ENSO) and commodity prices. Because the study will be based on the assumption that a correlation between ENSO and commodity prices exists in



# ABSTRACTS

PS

in Northern Florida; both linear and logarithm models, as well as econometric equations will be used to measure the hypothesis. These models fulfil a crucial role in evaluating the policy implications of climate change and how its effects can be mitigated.

## Public Preferences for Improving Water Quality in Spring-Fed Recreational Areas.

Victoria Smith-Thomas, Michael H. Thomas, Daniel Solís

This study uses contingent valuation to determine consumer's willingness-to-pay (WTP) for reducing hydrilla in two alternative spring-fed river systems in Northwest Florida - the Wacissa River (an open access park) and the Wakulla Springs (a gated park). Two dissimilar payment vehicles -gate and power bill fees- are used to assess the economic value of reducing the density of this aquatic weed. A total sample of 317 recreational users was used to estimate their WTP for a 50% reduction in the density of hydrilla. Our results show a favorable response from consumers to pay for a hydrilla reduction program. Specifically, at Wakulla Springs, the average WTP is \$1.63 for monthly power bill surcharge and \$3.76 for per trip gate fee. Conversely, at the Wacissa River the average WTP is \$1.49 power bill surcharge. This study also analyzes the determinants affecting consumer's WTP. Our results show that respondents who are from the local surrounding area are more likely to participate and pay a program to reduce hydrilla. In addition, the amenities available in the park also influence consumer's WTP. Policy implications stemming from these results are also discussed.

## Wise Traveler

Jaraad J. Johnson

My instinct and restlessness give an incentive to quest. I love experiencing different places and people. As a leaf moves about in the wind, I reflect a similar current in life. I find myself in multiple places in short intervals of time. A vessel of observation, I absorb all the fine properties of every setting I am part of. Equally, I invest my own accumulated energy into each location I visit. My nature consists of adaptation, lifelong education, and genuine love for all things created. Where ever I visit, becomes home. I begin to intertwine my spirit with the spirit of the sacred place I'm in. My thirst for knowledge leads to a humble attempt to learn the history of my surroundings. My thought process connects the right people together at appropriate times. I know that I am a wise traveler because everywhere I visit, I convey a message of healing.

## China

Tyler Bingham

Have you ever lived in a country where you cannot drink the water, it is strongly advised that you wear a mask when outdoors and the quality of food is in short supply due to climate and environmental issues of the area? Well, I have, while studying abroad in Shanghai, China. To say the least, I experience all of these on a daily basis. As China is rising to be a developed country and make international headway, they are dealing with their rising population and environmental issues, and are in need of a major change.





# ABSTRACTS

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Though the question is “how is China going to contain and minimize their carbon footprint, while still providing for the growing population as well as making a permanent stance in the international community? The answer is China’s government policies.”

In the past, China has been reluctant to change though since the PRC was established in 1949, they have made considerable change in accepting the modern world. However, they are firm on their stance in maintaining Chinese nationalism. To understand China, one first has to understand Chinese history. The purpose of this presentation is to give a brief overview of Chinese history and how that has impacted previous and present policies and how will China create a road map to reduce its current domestic and international problems.

**Food Agricultural Research Module (F.A.R.M)**  
Ryan McDugle

There is a serious issue of food Deserts plaguing America today. A Food Desert is an area of which there is a lack of access to food for the population in the area. These communities are often affected by poverty and residents have minimal transportation. The idea of the Food Agriculture Research Module (F.A.R.M.) will aim to combat this issue in an innovative manner. This structure will consist of the seamless integration of Aquaponics and Hydroponics. Although the majority of all growing efforts will take place inside there will be available space outside to practice outdoor growing methods. Another functionality of this project will be to provide research space to help develop new advancements on old and prior farming methods. The combination of Hydroponics and Aquaponics will

allow for maximum production of food sources. The facility will be able to support the growth of various fish types, dependent on the operators’ preference. Water will be supplied from the fish holding tanks into the hydraulic flowerbeds. This water will contain the waste from the fish, which will act as an organic fertilizer for the plants being grown. Growing despite climate conditions will be possible because the majority of plants will be grown indoors. Another benefit of using the F.A.R.M is the potential use of Climate Rooms. These Climate Rooms can be used to create the perfect conditions artificially inside a closed setting, which can allow for the potential growth of plants foreign to the region. Usage of the hydroponic and aquaponics systems will allow for fresh food and farmed fish to be sold directly to the community.

The F.A.R.M not only aims to increase the availability of food in areas of need but also focuses on community development. These facilities are to be directly placed inside the communities considered as food deserts. All F.A.R.M facilities will have to be staffed at various levels of expertise. Efforts of this project will be to educate members of the surrounding community, which could potentially led to the creation of a workforce. There will be areas at the facility to conduct demonstrations and programs for children. The subject matter of these interactions will be based on good nutritional practices and sustainability efforts. This will aid in creating a future generation that is environmentally conscious and knowledgeable about innovative farming techniques. Also there will be programs designed to provide information for adults and the elderly on ways to ensure adequate nutrition and how to develop a personal home gardens.













# PLENARIES





**#1**

# OPENING PLENARY

## Opening the EnergyWaterFoodNexus Dialogue

### Speakers

**Charles Fishman**

Best Selling Author

**Larry Robinson, Ph.D.**

Distinguished Professor,  
School of the Environment

**Peder Maarbjerg**

Assistant Director,  
Dept. of Energy, ARPA-E

**Istvan Kenyeres**

CEO and Co-Founder  
Biopulus Hungary

**Dimitri Corpakis, Ph.D.**

Head of Unit, Research and Innovation  
European Commission

### Plenary Highlights

The first plenary session provided an introduction to the need for a nexus approach to the problems in the energy, water, and food arena. The speakers addressed topic in each of these areas and then converged to tackle nexus solutions to these problems.

Panel members were drawn from private industries, government and educational institutions including Florida A&M University. They discussed the implementation of practical solutions through research and commercialization of technologies that advance renewable energy, increase access to safe drinking water and promote natural resource conservation.





**Charles Fishman**  
Best Selling Author





# OPENING PLENARY

## Opening the EnergyWaterFoodNexus Dialogue

Best selling Author, Charles Fishman touched on several points to prepare audience on the plenary discussion panel's dialogue on EnergyWaterFoodNexus. Highlights of Speech by Charles Fishman include:

- \$7 FIGI bottle of water.
- 50% of the people in India do not have access to clean safe water in a country.  
with enough water, money and science for everyone.
- Water is necessary for energy and food.
- Economic development and climate change affect water management.
- Saving water saves energy and provides sustainable food.
- Water needs innovation.
- 40% drink, cook and bathe in water dirtier than water in our toilets.
- More have cell phones than clean water.
- Average Am 100 gpd, electricity at home requires 250 gpd, 45% of US water goes to electricity, food is next. 8% of electricity goes into moving water.
- Weather change is real.
- Perth in AU, 20% less rain. 75% less in reservoir.
- US uses 10% less water than 45 years ago.
- Few understand where water comes from and goes.
- Indian women carry water 12 Km for one flush of a US toilet.
- Settlement in Dalai with one faucet. Stood in line. They created their own utility for \$2.50/mo. 5x what we pay for water.
- Ultra pure water needed for computer chips. Water energy scientists doubled the value of the water. Saved \$15m/yr. and IBM will help you use smart water.
- Water problems are local and must be solved. We need revolutions.
- ½ of water professionals retire in the next 5? years
- Life requires water, cells, snowflakes, concrete, etc.
- Water is reusable; there is no new water. Every drop has been dinosaur pee.

A photograph of Larry Robinson, Ph.D., a distinguished professor, speaking at a podium. He is shown in profile, facing right, wearing a light blue suit jacket, a white shirt, and a blue and white checkered tie. He has a grey beard and is wearing glasses. A microphone is positioned in front of him. The background is dark and out of focus.

**Larry Robinson, Ph.D.**  
Distinguished Professor,  
School of the Environment

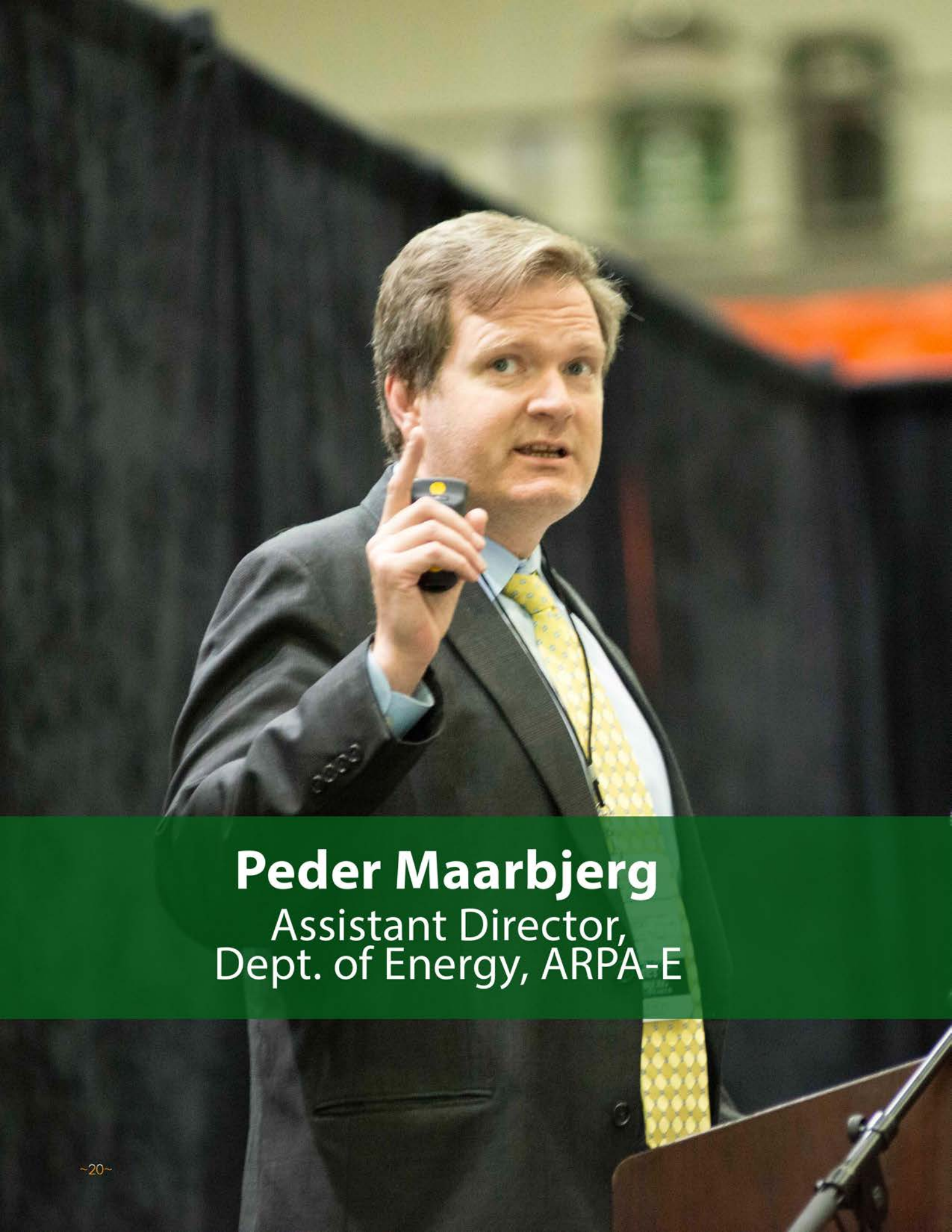


# Opening the EnergyWaterFoodNexus Dialogue

Dr. Larry Robinson, Distinguished Professor at Florida A&M University's School of the Environment delivered another one of the opening speeches to kick off panel's dialogue on EnergyWaterFoodNexus. The focus of the Speech and highlights are as follows:

## **National Ocean Policy and the EnergyWaterFoodNexus**

At present, at the federal level, human activities in our oceans, coasts, and Great Lakes are regulated by over 140 statutes, regulations, and policies. We need a more holistic and integrated management structure. This requires top-down coordination and implementation of regionally-informed priorities that come from the bottom-up. This structure must be informed by people living and working in the regions that understand local issues and know how to maneuver to get things done. The National Ocean Policy for Stewardship of the Oceans, our Coasts and the Great Lakes offer an overarching vision of regionally-informed ecosystem-based management aimed at promoting healthy marine and coastal ecosystems, communities, and economies that are resilient in the face of change. Our oceans, coasts and Great Lakes serve as a true "nexus" for energy, water and food. The National Ocean Policy will be discussed as an innovative management tool needed to preserve these resources well into the future.



**Peder Maarbjerg**  
Assistant Director,  
Dept. of Energy, ARPA-E



# Opening the EnergyWaterFoodNexus Dialogue

Peder Maarbjerg, Assistant Director for External Coordination at the United States Department of Energy's Advanced Research Projects Agency - Energy (ARPA-E) delivered one of the opening speeches to kick off panel's dialogue on EnergyWaterFoodNexus. The focus of the Speech and highlights are as follows:

## **ARPA-E Programs and Relevancy to the EnergyWaterFoodNexus**

The Advanced Research Projects Agency-Energy (ARPA-E) accelerates the advancement of transformational energy technologies to enhance the economic and energy security of the United States by investing in high-potential, high-impact energy projects that are too early for the private sector. Launched in 2009, ARPA-E explores uncharted territories of energy technology to generate options for entirely new paths to create, store and use energy. Commitments towards this include a \$60 million funding for 23 groundbreaking new projects aimed at creating highly efficient and scalable dry-cooling technologies for thermoelectric power plants and developing prototype technologies to explore new pathways for fusion power. The projects are funded through ARPA-E's two newest programs, Advanced Research In Dry cooling (ARID) and Accelerating Low-cost Plasma Heating and Assembly (ALPHA), which both seek to develop low-cost technology solutions.



## **Dimitri Corpakis, Ph.D.**

Head of Unit, Research and Innovation  
European Commission



# Opening the EnergyWaterFoodNexus Dialogue

Dr. Dimitiri Corpakis, Head of Unit, Research and Innovation at the European Commission delivered one of the opening speeches to kick off panel's dialogue on EnergyWaterFoodNexus. The focus of the Speech and highlights are as follows:

## **Innovation at the European Union**

Smart specialization, innovative governance solutions, new linkages, synergies and spill-overs, entrepreneurship etc. The European Commission will invest almost €16 billion in research and innovation in the next two years under Horizon 2020, the EU's research and innovation funding scheme, following a new work program for 2016-17 adopted on 13 October. Horizon 2020 is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. Seen as a means to drive economic growth and create jobs, Horizon 2020 has the political backing of Europe's leaders and the Members of the European Parliament. They agreed that research is an investment in our future and so put it at the heart of the EU's blueprint for smart, sustainable and inclusive growth and jobs. By coupling research and innovation, Horizon 2020 is helping to achieve this with its emphasis on excellent science, industrial leadership and tackling societal challenges. The goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation. Horizon 2020 is open to everyone, with a simple structure that reduces red tape and time so participants can focus on what is really important. This approach makes sure new projects get off the ground quickly – and achieve results faster.

The EU Framework Programme for Research and Innovation will be complemented by further measures to complete and further develop the European Research Area. These measures will aim at breaking down barriers to create a genuine single market for knowledge, research and innovation.

A photograph of Istvan Kenyeres, an older man with white hair and a beard, wearing glasses and a dark suit. He is speaking at a wooden podium, looking slightly to the right. The background is blurred, showing some lights and a dark curtain.

**Istvan Kenyeres**  
CEO and Co-Founder  
Biopulus Hungary



# Opening the EnergyWaterFoodNexus Dialogue

Istvan Kenyeres, CEO and Co-Founder, Biopolus Hungary, delivered one of the opening speeches to kick off panel's dialogue on EnergyWaterFoodNexus. The focus of the Speech and highlights are as follows:

- Water Scarcity, safety and security map.
- Water will be 58% of our infrastructure cost by 2020.
- Uses sewage for profitable products: machines to living factories.
- In 100 years: Population from 1/5 to 7 billion, life expectancy from 30-70, domesticate mammals NA to 97% urbanization 10-55%.
- Simple flow-through urban system: closing the metabolic loops (water energy, food, etc).
- Metabolism of carbon, etc.
- Patterns of complexity, roads, microchip, metabolism – Integrated technologies (water, energy, food, waste) body organs are nodes. Urban organs: schools, hospitals, churches, and NEW Metabolic Hubs.
- Budapest central park redevelopment: Biopolus, zoo, spa, etc.
  - Energy and Material flow scheme > linear > circular integrated metabolic loops save 65% energy 95% water, 90% waste.
  - Hub part of Aoo with sewage treatment, renewable energy bio-waste processing, microscopic, palace of water miracles, living factory.
  - Produces 9MW, recycles water 10,000 m<sup>3</sup>/d organic waste processing, 5K/yr.
- Low income, slum solutions (est. 50% in slums in 2050) modular, scalable, sustainable, standardized.

# PLENARIES





# #2 OPENING PLENARY

## Emerging EnergyWaterFoodNexus Trends



### Plenary Panel

- |                         |   |
|-------------------------|---|
| <b>Dean Minardi</b>     | CFO, Bing Energy  |
| <b>Bridgette Bell</b>   | Senior Manager of Global Sustainability, Yum! Brands, Inc |
| <b>Phyllis Newhouse</b> | President and CEO, Xtreme Solutions                       |
| <b>Will Allen</b>       | Farmer, Founder and CEO of Growing Power                  |



**Will Allen**  
Farmer, Founder and CEO of  
Growing Power



# LUNCHEON PLENARY

## Emerging EnergyWaterFoodNexus Trends

Will Allen, Farmer, Founder and CEO of Growing Power touched on several points while digging deeper into the emerging trends in the EnergyWaterFoodNexus. Highlights of the Keynote speech by Will Allen include:

- Farming in Will Allen's family as a way of life goes back 400 years.
- We don't have good food" – we really don't know what we are eating and if the food we consume has any real value to us : Our food should be our medicine.
- Michelle Obama prompted ~10 million home growers and inspired even more to begin thinking about what they eat.
- Mr. Allen attempts to inspire...there are 100's of jobs revolving around the good food industry: There is a need to "grow some farmers" in order to feed the blooming population.
- Growing Power started in 1993: At Growing Power there are 300 acres for growing food outside and 25 acres of controlled climate environments for year-round production.
- There is a need to get back to teaching folks basic skills revolved around the good food industry: food preservation, cooking, the use of basic tools, etc: The only way to grow good food is to grow good soil.
- "Flower Explosions" in vacant lots and the areas b/w the streets and sidewalks have helped to beautify the inner city and shift perceptions of farming.
- Growing Power has 25 "other farms" – there is the ability to feed 10,000 people from one 3-acre farm comprised of greenhouses.
- Annually, Growing Power collects 40 million pounds of food scraps to generate compost for operations.
- In the city you must grow up because you can't dig down (compost used as filling for raised beds).
- It all starts with the soil – worms produce the best organic fertilizer in the world. Feed worms compost (1 pt carbon / 1 pt nitrogen): Growing Power has worms valued at \$300k.
- One of Growing Power's focuses now is putting organic markets/cafes in food desert areas.
- They are also trying to attach greenhouses to schools and parks and encourage the youth to get involved in building and maintaining them.
- "Mini hoop-houses" make great projects for kids in camps to build.
- If you're going to work with teens, you're going to have to pay them!





**Andre H. Sayles, Ph.D.**  
Principal Deputy Director of the  
Office of Economic Impact and Diversity DoE



# EVENING KEYNOTE

## Emerging EnergyWaterFoodNexus Trends

Dr. Andre H. Sayles, Principal Deputy Director of the Office of Economic Impact and Diversity, U.S. Department of Energy (DoE), touched on several points while digging deeper into the emerging trends in the EnergyWater-FoodNexus. Highlights of the Keynote speech by Dr. Andre Sayles include:

- Mission of office: Impact of energy on minorities, impact builds on other discrimination. Environmental Development, climate change, jobs, environmental justice, education, etc. related to minorities.
- Nexus of energy, water and food. Poor pay 50 cents/SF more than higher income. Benefits go to owners, not renters. Little aid or incentives for landlords. Poor least likely to be able to pay. No insurance after a disaster and other higher losses.
- Functional responsibilities concerns of: Department of the Interior, Department of Environmental Protection, Department of State, Department of Defense, and others concerned with energy.
- Water Energy Tech Team at DoE looking at the nexus with international partners. All energy sources connected to water. Less for wind.
- Wastewater treatment, bioenergy, etc. on DoE schedule.
- Research is key. We can also model water.
- Policy is needed but much is state and local. Energy and wastewater rights are different.
- Challenges: climate change, population growth, regional policy obstacles, ice melts, droughts affect hydro. There are costs of shortages.
- Music, literature, love; No more water ever but we can have more love.
- Food production needs to double.
- How are vulnerable minorities affected by energy, water and food?
- Federal agencies are interested and responsible for what you are doing here and will back you.



Day one of the EnergyWaterFoodNexus saw participants engage in a Pre-Summit reception sponsored by the Clean Energy Technology Center and its coalition. Florida A&M University convened this Summit to promote discussion, scholarship and collaboration among researchers, students and entrepreneurs that advance science, policy and decision-making. This global public-private partnership sought to generate practical solutions through research and commercialization of technologies that advance renewable energy, increase access to safe drinking water and promote food security. Various technologies in alternative energy were showcased at this reception.

## Photo Gallery















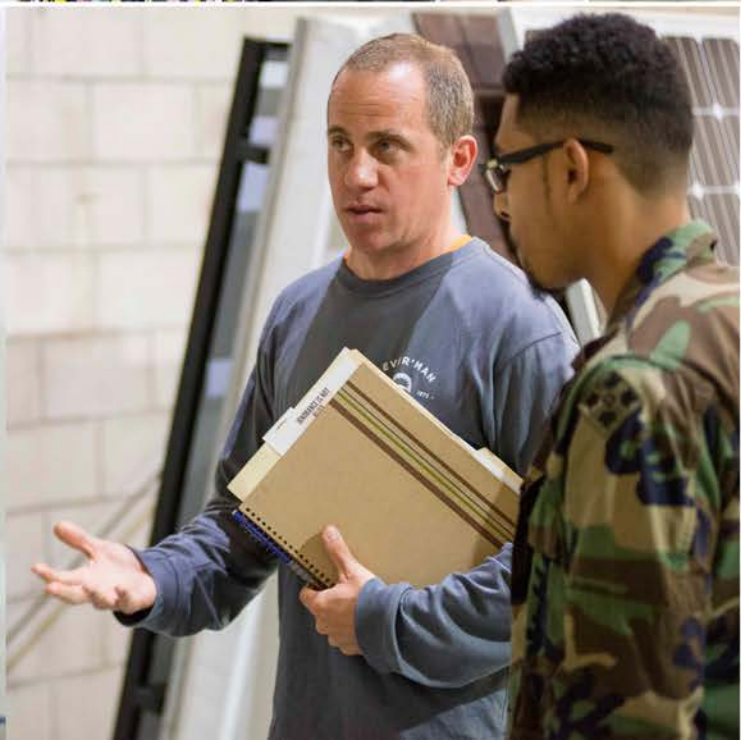


**SOLECTRIA RENEWABLES**  
**SGI 500XT, SGI 500XTM, SGI 750XTM**  
UTILITY-SCALE INVERTERS

- FEATURES**
- External Transformer Inverters
  - 98% CEC Efficiency
  - 600 or 1000 VDC
  - Built-In Redundancy
  - Subcombiner Options
  - Modbus Communications
  - User-Interactive LCD
- OPTIONS**
- Uptime Guarantee
  - Stainless Steel Enclosure
  - Web-Based Monitoring
  - Built-in Cellular Connectivity
  - AC Breaker with Shunt Trip
  - Revenue Grade Metering
  - Air Filters
- OPTIONS FOR UTILITIES**
- Real Power Curtailment
  - Reactive Power Control
  - Voltage Ride Through
  - Frequency Ride Through
  - DMS Tie-In
- © Built for the real world.

**ARTGRID 750XTM**









Day 2 of the Summit had participants engaged in various activities including speaking and interactive sessions. The EnergyWaterFoodNexus (EWFN), a new science enterprise led by the FAMU School of the Environment, is designed to expand the research frontier for new discoveries that integrate systems-based research and education for solutions for the vexing global energy, water and food crisis. Florida A&M University is convened this Summit to promote discussion, scholarship and collaboration among researchers, students and entrepreneurs that advance science, policy and decision-making. Most importantly, this inaugural Summit and others that will take place bi-ennially create an international hub and a platform for global discussions that allow participants to present innovative ideas for sustainable solutions. The Summit thematic tracks — New Science Enterprise, Accelerated Innovation, Science Based Policy and Decision-Making, and Idea Hacks — were carefully selected to spur new ideas that contribute to the nexus solutions.

## Photo Gallery

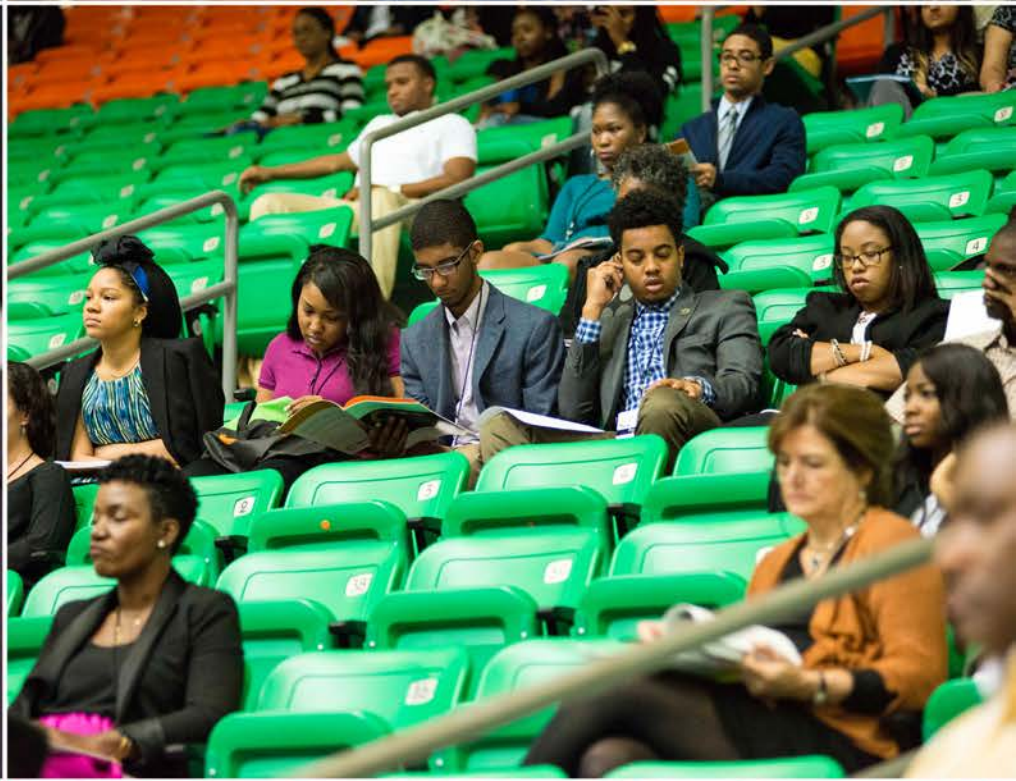
























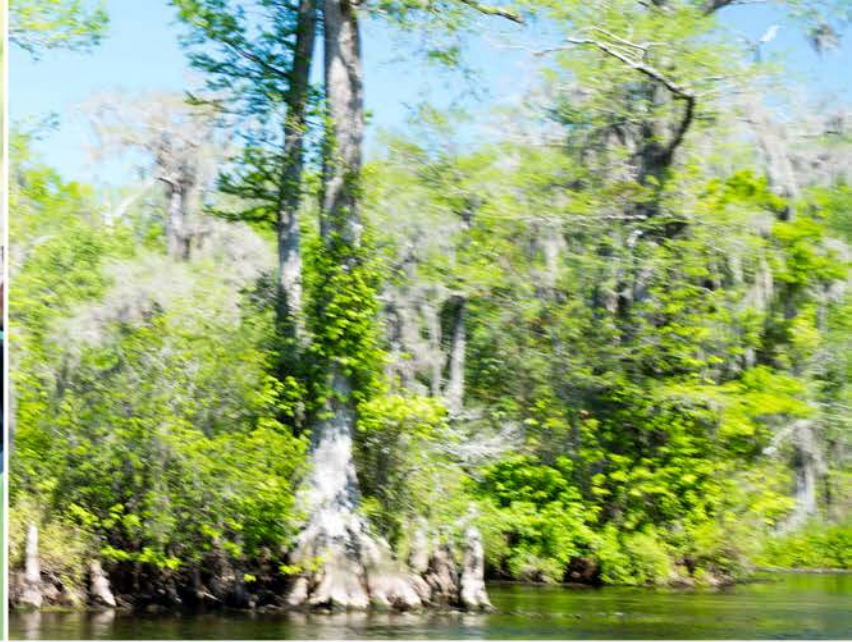
Day three of the EnergyWaterFoodNexus saw participants engage in an Eco-Tour which began with a tour of the Wakulla Environmental Institute and culminated with a tour of Wakulla Springs. This Eco-Tour helped to demonstrate the natural resources of the community and the importance of sustainability considerations in preserving them.

## Photo Gallery





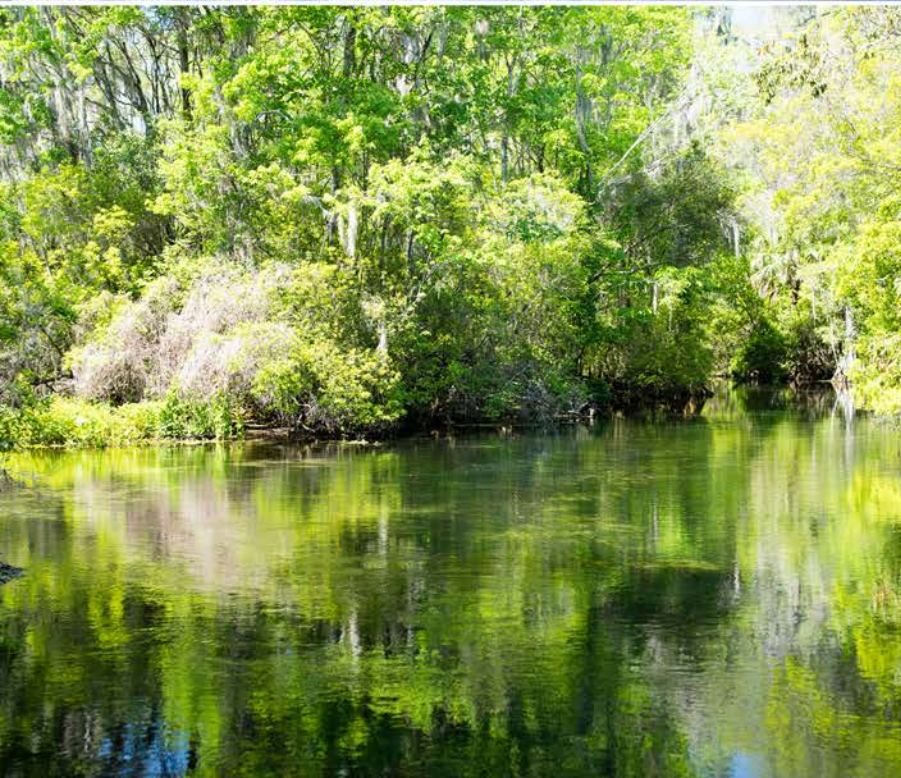




















# CONCURRENT SESSIONS







# Science Enterprise

*1. New frontiers in Renewable Energy; 2. Meeting the Global Water Challenge; 3. Emerging Trends in Water Research; 4. Technology Applications*

## Track 1: New frontiers in Renewable Energy

### Session Chair & Moderator

Mark Weatherspoon,  
FAMU-FSU College of Engineering

### Panelists

- 1 Larry Morris Jr.  
FAMU-FSU College of Engineering
- 2 Venroy Watson  
FAMU-FSU College of Engineering
- 3 Annadanesh Shellikeri  
FAMU-FSU College of Engineering

## Track 2: Meeting the Global Water Challenge

### Session Chair & Moderator

Odemari Mbuya  
College of Agriculture and Food Sciences,  
FAMU

### Panelists

- 1 James Jones, Director  
Florida Climate Institute
- 2 Oghenekome Onokpise, Ph.D.  
College of Agriculture and Food Sciences,  
FAMU

## Track 3: Emerging Trends in Water Research

### Session Chair & Moderator

Clayton Clark  
FAMU-FSU College of Engineering

### Panelists

- 1 Dan Osborne  
School of the Environment. FAMU
- 2 Jennifer Cherrier  
School of the Environment. FAMU
- 3 Jorge Olaves  
Director of Aquatics, FAMU

## Track 4: Technology Applications

### Session Chair

Ashvini Chauhan,  
School of the Environment. FAMU

### Session Moderator

Charles Jagoe  
School of the Environment. FAMU

### Panelists

- 1 John Ericsson  
CEO, Algastar
- 2 Ashvini Chauhan,  
School of the Environment. FAMU
- 3 Rachel Young  
American Council for an Energy  
Efficient Economy



*1. New Developments in Energy, Law, Policy, and Practice; 2. Sustainable Communities; 3. Climate Smart Agriculture; 4. Sustainable Corporate Strategies*

## Track 1: New Developments in Energy, Law, Policy, and Practice

### Session Chair

Randall Abate  
College of Law, FAMU

### Session Moderator

Ralph DeMeo, Esq.,  
Hopping, Green & Sams

### Panelists

- 1** Keith Rizzardi, St. Thomas Law School, Miami
- 2** Jeffery Ray, Esq., The Ray Law Firm, PLLC
- 3** Damilola Olawuyi, Executive Director Institute of Oil and Gas, Energy, Environment and Sustainable Dev., Nigeria

## Track 2: Sustainable Communities

### Session Chair & Moderator

Elizabeth Lewis, School of Architecture, FAMU

### Session Moderator

Olivier Chamel, School of Architecture, FAMU

### Panelists

- 1** Elizabeth Lewis, School of Architecture, FAMU
- 2** John Motloch, Co-director Sustainable Communities Institute

## Track 3: Climate Smart Agriculture

### Session Chair

Richard Gragg  
School of the Environment, FAMU

### Session Moderator

Cynthia Harris, Institute of Public Health, FAMU

### Panelists

- 1** Bharat Patel, National Council for Climate Change, Sustainable Development and Public Leadership, India
- 2** Kirit Shelat, National Council for Climate Change Sustainable Development and Public Leadership, India
- 3** Dot Inman-Johnson, City Manager Midway FL

## Track 4: Sustainable Corporate Strategies

### Session Chair & Moderator

Keith Bowers, Regional Director  
Small Business Development Center, FAMU

### Panelists

- 1** Bridgette Bell, Senior Manager of Global Sustainability, Yum! Yum Brands, Inc.
- 2** LaQuinda Brewington, Mosaic
- 3** Cristin Burns, Project and Marketing Manager, New Leaf Market Co-op



# Science Based Policy & Decision Making

*1. Building Sustainable Communities Through New Land use Policies; 2. Every Drop Counts; 3. Zero Hunger - Ideas for Feeding the World; 4. Agricultural Solutions*

## Track 1: Building Sustainable Communities Through New Land use Policies

### Session Chair

Adam Jacobs,  
City of Tallahassee

### Session Moderator

John Baker,  
City of Tallahassee

### Panelists

- 1 Michael Duncan,  
Florida State University
- 2 Will Butler  
Florida State University
- 3 Dan Donovan, Tallahassee  
Leon County Planning Department

## Track 2: Every Drop Counts

### Session Chair & Moderator

Nathaniel Bailey, College of  
Agriculture and Food Sciences, FAMU

### Panelists

- 1 Bill Bartnick, Florida Dept. of  
Agriculture and Consumer Services
- 2 Y.Ping Hsieh, College of Agriculture  
and Food Sciences, FAMU
- 3 Rick Copeland, College of Agriculture  
and Food Sciences, FAMU

## Track 3: Zero Hunger - Ideas for Feeding the World

### Session Chair

Sharmini Pitter, College of Science  
and Technology, FAMU

### Session Chair

Harriet Paul, College of Agriculture  
and Food Sciences, FAMU

### Panelists

- 1 Bakari McClendon  
Tallahassee Food Network
- 2 Sanjay Deshmukh, National Council for  
Climate Change Sustainable Development and  
Public Leadership, India
- 3 Jennifer Taylor  
FAMU Extension

## Track 4: Agricultural Solutions

### Session Chair & Moderator

Oghenekome Onokpise, College  
Agriculture and Food Science, FAMU

### Panelists

- 1 Kenneth Boote,  
University of Florida
- 2 Camilo Gaitan, Florida Dept. of  
Agriculture and Consumer Services
- 3 Glyen Holmes II, College of  
Agriculture and Food Sciences, FAMU





# SESSION SUMMARIES



## *1. New frontiers in Renewable Energy; 2. Meeting the Global Water Challenge; 3. Emerging Trends in Water Research; 4. Technology Applications*

### 1 New frontiers in Renewable Energy

**Summary:** The session focused on the potential utilization of sustainable storage strategies for efficient renewable energy systems. Reducing carbon footprint by utilizing Particle Filter to estimate battery states was discussed. The session asked the question: Can the Particle Filter be implemented in MATLAB using measured or simulated battery data. Using measured and simulated data, it was seen that the Particle Filter works.

The panel also discussed the need to produce more food/land area while reducing carbon footprint. To achieve this, energy storage systems: RFB (redox flow battery) which are cheap & non-toxic was presented as an alternative source of energy. It works by capturing wind energy. Ways to combine electrolyte systems to lead to better battery performance was also discussed.

The Low-cost high power Li-iron Phosphate (Li-FePO<sub>4</sub>/LFP) Battery was presented as another energy source. Advantages of this system include that it is lighter in weight, takes up less space, has a longer life cycle, high (peak) power ratings, has more applications, is less toxic and cheaper. The panel also discussed its disadvantages which consisted mostly of its higher production cost and toxic solvents used in production. An alternative production method proposed to mitigate these disadvantages was the dry method battery electrode fabrication. This would minimize toxicity, costs and can benefit distributed energy systems.

### 2 Meeting the Global Water Challenge

**Summary:** This session explored the nexus perspective on energy-water-food in three ways: Society, Economy and Environment. The speakers presented the issue of water, food and energy security and how to accelerate access to these resources for the society by integrating solutions to urbanization, population growth and climate change. The beginning of discussions on the solutions included the examining past paradigm shifts in the treatment of the environment from such ground breaking though leaders as Rachel Carson and her book "The Silent Spring".

The speakers then analyzed where the world has been since then by chronicling the green revolution movement which they dated as pre-1960s – 1970s movement which combined plant breeding with fertilizers and increased management intensity and established international agricultural research centers. The panel discussed potentially transformative contemporary challenges citing, population increase, climate change, food security, water security and energy security. The panel then took the audience through the need for agricultural responses in the future that would ensure sustainable solutions to food systems, energy systems, and water resources. Impacts on Environmental and ecological systems were also considered. Complex challenges such as the nexus of population, food, water, energy, and climate change require transdisciplinary efforts to evaluate alternative strategies, practices, and policies.



## SESSION SUMMARIES

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Agriculture and natural resources are key components. Agricultural models are essential tools, and are being used to analyze alternatives and tradeoffs among alternative decisions & policies, and to gain insight into future solutions, and to complement experimental research. To get a grasp of the significance of agricultural impact, the speakers comparing US droughts: 1988 and 2012 using Agricultural Models. Hindcast 1979-2011 with detailed parameterizations of technology. Findings also revealed more % yield loss in 1988. Also, counterfactual of 1988 with 2012 weather and 2012 with 1988 weather, showed that 2012 drought was notably more severe. Finally, the analyses showed that corn production is more resilient to drought now than 1988. Also analysis of the California Drought showed over \$20 billion of agricultural products annually! That it is entering 4th year of severe drought. In 2014, about 400,000 acres were left unplanted and in 2015, over 1,000,000 were likely to be lost. Conclusions of the situation analysis revealed that irrigation is required. The panel asked the question: Should Agriculture Migrate to the Southeast USA? Implications of that would mean more rainfall, higher humidity mean higher water use efficiency more stable water supply for irrigation, and at the same time, lower irrigation requirement for crops. Thus, some are promoting more irrigation in SE USA to increase economy and conserve water..

Other agricultural responses to food and water security threats include 1. Increase water use efficiency; 2.) Plant breeding; 3.) Rainwater harvesting; 4.) Irrigation ; 5.) Policies; 6.) Adaptive management systems; 7.) Insurance Diversification; 8.) Change enterprises; 9.) Shifting agriculture

### 3 Emerging Trends in Water Research

The panel discussed the need for developing sources of energy at low cost. The speaker discussed wave technology and underground/ocean current technology which already exist and proposed other ways to utilize this technology and how Florida A&M University could play a significant role in developing and training experts on

this. Florida A&M University already has a program of study that allows the students to apply their aquatic knowledge from running water technology systems and participation and supervision in different aspects of the field.

### 4 Technology Applications

This session examined biofuel production, advances in Gulf coast research, and opportunities for water utilities and water conservation to reduce emissions. Algae can be used to solved the problems in different filed (environmental remediation, waste removal, energy regeneration, pharmaceutical candidates. Algastar offer a novel way to cultivate algae. To increase the growth rate of algae, one of the resources of biofuel, the key technique are 1.) Magnetic field, and 2.) Microwave energy (similar to FM signal wavelength). By applying this technology, the totally growth rate of algae can be reach 50-500% higher than traditional cultivating method (huge field pond). Low cost, ecofriendly, can be used to reduce CO2 from environment. Algae offers as a good resource for Kerosene, gasoline, diesel fuel, and omega 3 oil. Because one of the ingredient to culture the algae is CO2, they have collaborated with others to test CO2 consuming ability in this system. Also, different kind of microbes are tested to cultivate in this system to see the effect (one of the collaboration is with Dr. Chauhan, FAMU). The kind of algae used is *N. oculata*.

Engage FAMU to build microwave to optimize growth processes to multiply growth rate of algae Project: 5000 gal photobioreactor that send energy into the water that will increase biomass production. (Shown to increase 35-45%), low energy consumption. Benefits include: Biomass turbocharger that is energy and cost efficient and maximizing biomass production. Organisms that have been bio-stimulated include Cyanobacteria, Microalga (most significant increase of growth rate), and yeast.

The panel also discussed coupling microalgae in the presence of wastewater nutrients that will clean wastewater to be used to grow a product. The speakers proposed that Isolating microbes from waste water and using it to clean wastewater may be good candidates for



biofuel production in the future. Isolation method discussed was flow cytometry

Other speakers on the panel introduced the American Council for Energy Efficient Economy (ACEEE) which does research reports. The panel discussed some of the ACEEE research projects which include 1.) Wastewater facilities becoming energy neutral and home use of energy and water 2.) University of Texas, Austin water-energy program with water as its largest use of energy 3.) Best practices: Boulder, Darden Restaurants, Massachusetts Water Resources Authority, S CA Edison, United Technologies Corporation 4.) Colorado Government Energy Office goal of 20% energy reduction. Under the Colorado Government Energy Office project, discussion points

included emergency performance contracting, upgraded 57 buildings and irrigation systems, and scored big savings on capital. The take away for that project is that partnering, long payback/life cycle, unique measures for energy and water. The panel also discussed South California's leak detection pilot program whose objectives include, ID consumption, metering errors and leakage. This project also achieved big savings in capital. The Environmental protection Agency's clean power plan was among the research projects. The ACEEE will continue to Improve study variables for energy in terms of water and water for energy.







# SESSION SUMMARIES



## *1. New Developments in Energy, Law, Policy, and Practice; 2. Sustainable Communities; 3. Climate Smart Agriculture; 4. Sustainable Corporate Strategies*

### **1 New Developments in Energy, Law, Policy and Practice**

Summary: Worldwide population is increasing, thus the worldwide food demand is also increasing. About 51% of the world live in China, India, Indonesia, Bangladesh, Japan, Vietnam, the Philippines, Burma, Thailand, South Korea, Nepal, Malaysia, North Korea, Taiwan, Sri Lanka, Cambodia, Laos, Mongolia, and Bhutan, which is about 51%. We have to feed all of these people whose culture primarily involves fish for food consumption. China consumes 42 million tons of seafood versus 7 million tons by U.S. (UN Food and Agriculture Organization) Thus, we are going to have to be thinking about aquaculture to accommodate everyone. Examples of different types: pools of water on land, shoreline aquaculture, such as shellfish industry, but there are also finfish aquaculture in the ocean. With global warming there is a potential for meat and seafood: cows, goats, etc., would have the biggest carbon footprint versus raising fish in aquaculture farms. Technology is getting better, so there are ways to modify fish reproduction such that fish held in aquaculture are not able to reproduce if they were able to escape, such as with the “Rigs-to-Reefs” program – instead of decommissioning rigs which allows them to become reef habitats for fish.. Laws to support sustainability include the Magnuson Act, a streamline scheme for allowing aquaculture purposes to go forward (Gulf aquaculture). We should however think globally, not locally because there are trade-offs; if we don't change, we aren't going to be

able to meet human food demands or gain economic benefits.

The panel then discussed Florida's Potential Offshore Energy – Wind. U.S. offshore energy leases only take up 2% of available surface area; currently, there are no commercial farms producing wind due to debates, construction, and etc. US offshore energy is currently dominated by oil and gas industry. Europe has been producing offshore wind since 1991 and has at least 66 wind fields operating currently. U.S. Planning Issues: it takes about 3 years just to work out the kinks in understanding what's going right or wrong, and then worry about federal versus state water politics and lobbyists (permitting issues). U.S. designed turbines to produce 3-5 megawatts per turbine versus Europe's design is 4-7 megawatts per turbine.

The panel then asked the question: do we subsidize these or not? In the U.S., we tend to drive towards renewable energy when cost of gas prices is up versus when the cost is low. In the U.S., we have prescription-based regulations, which are not good because we continue to have to reset the law, versus goal-based regulations, which are more effective. Energy security must be considered in the energy portfolio; lately, coal has been considered to remove coal from the energy portfolio because of the economic liability of it. How do we get some of the investors interested? Their money will be locked in for a long period of time before receiving the economic benefits. Thus, incentives can be an attractive pull (state/county/regional levels).



## SESSION SUMMARIES

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Commercial trade restrictions – transmission lines that comes ashore may belong to one state or could be intrastate laws; Obstruction of marine life, commercial transportation (ships importing/exporting goods), and potential declination of land value for coastal areas in sight of energy platforms – thus, at what point does it become a burden to have wind farms? Negatives: as global temperatures increase, then wind patterns may change and could decrease its effectiveness of this “fixed” installment (investor concerns); local businesses may be negatively impacted, such fish excursion tours, etc., due to the structure. U.S. Legal: different laws dealing with wind energy in some capacity – NEPA, CSMA, MBTA, CCA 2008, Electricity Act of 1989. The panel also discussed International Issues in Energy with a focus on Nigeria.

For many years, Nigeria has been the superpower in oil/gas production and the U.S. has been a major customer; yet, the last couple of years, business have been slow due to Shell, so supply/demand for Nigeria’s oil is low. Ever since the discovery of oil in Nigeria, there was a boom in oil and job opportunity and nothing else really mattered. However, now there is an urgent need to move into commercial agriculture because of food and because oil is no longer the main source of the economy. Thus, Nigeria have to move from oil dependence to agriculture. Yet, due to the lack of technology in agriculture (because there has not been a need for it since oil was the main dependence), technology, itself, is an area for investments. Yet, no one wants to invest there due to many issues (i.e., Boko Haram and militants). Thus, they are trying to reduce known sources of negativity, so that they can bring in more investors. Waste water management technologies and additional technology will be good to bring in, but there is a need to amend certain laws currently in place in order to reflect new change and current technology. Bureaucratic processes are also a challenge because investors would have to go through so many levels of government in order to get permits to bring in technology. Thus, they are trying to create a one-stop shop to make a smoother, easier process.

this. Florida A&M University already has a program of study that allows the students to apply their aquatic knowledge from running water technology systems and participation and supervision in different aspects of the field.

Thus the best way foreign institutions can support Africa/Nigeria is not through donations, etc., but to develop local solutions/technologies for farming. Empower them through expansion programs of water management and local farming as opposed to more money. There is an opportunity for more institutional collaborations. There is still a real need to enhance/create investment climate for investments to come in. Most importantly, there is a real need for international reform because without food, jobs, water, there will only be more problems and people will become more violent because people will try to grab their rights by force. Thus, international law and institutions should begin to develop more holistic solutions to be able to use the technology required to drive from, what is now, subsistence agriculture to commercial agriculture.

### **2 Sustainable Communities**

The panel examined the current state of building design and construction which accounts for nearly 50% of energy and 13% of water consumption in the U.S. yearly. About 8% of U.S. energy goes to treating, pumping and heating water. Reducing energy; water and land sprawl now, will help transition to a new order of things that can be sustained within the limits of natural systems. By 2035, three quarters of the US built environment will be either renovated or new construction. These must be designed as healthy, environmentally friendly and high performing “green buildings” to operate with far less energy and water than today’s average U.S. building. Buildings and landscapes are interrelated systems embedded in an ecological and cultural framework. Frameworks such as U.S. Green Building Council’s LEED, the Living Building Challenge, and International Green Building Code are critical to the interrelated links of energy, water and food in our future.



While the notion of food in the building sector seems not quite apparent, but many green building rating systems are now including agriculture as a required aspect of the design. K-12 Schools are incorporating community and school gardens as a means for social and community outreach while educating the younger generation on the importance of local unprocessed foods. Complex adaptive systems depend on their whole-system complexity to sustain full-functionality. To thrive, humanity must live appreciatively within this system complexity.

The Sustainable Community Institute (SCI) then discussed the need for living integratively. SCI uses Appreciative Inquiry (AI) processes to reveal data needed to live appreciatively, change with complexity, integratively manage energy, water and food systems (EWF Nexus), build local self-reliance and new economy entrepreneurship ... and thrive by living within system complexity. SCI helps communities integrate complexity science knowledge and vernacular knowledge about local system complexity to live appreciatively by managing the EWF Nexus and by interconnecting sustainability's triple bottom line -- ecological, social and economic -- with appreciative system dynamics to empower communities to thrive. SCI helps communities optimize, harvest from, use and regenerate the EWF Nexus. Finally the panel discussed how SCI helps communities integrate ecological, infrastructural, and built-environment supports systems. Also methods to interconnect previously disconnected decision-making, and empower integrative management of the EWF Nexus to sustain system complexity and full-functionality was analyzed. Finally an overview of SCI urban and rural projects in the US and globally was presented. Its aim is to help communities optimize the EWF Nexus and others focused on enhancing the ability of a key system – e.g., food -- to catalyze community change to thriving in the current context of accelerating system change.

### 3 Climate Smart Agriculture

**What Climate Smart Agriculture:** It is composed of four pillars: Increase agriculture productivity and income; Adapt and build resilience to climate change; Reduce GHG emissions without harming farmer's interest. Use agriculture as a major tool for mitigation of CO<sub>2</sub> - absorb CO<sub>2</sub> and release Oxygen through photosynthesis process. It envisages to achieve this through (a) increased cropping by reducing rain fed areas through integrated water and river basin management (b) expansion of agriculture on wasteland, wetland, degraded fallow areas and urban agriculture. It helps achieve sustainable development goals. Integrates and coordinates– social, economic and environmental development to meet the challenge of providing sustainable (a) livelihood to farmers (b) food security to hungry millions, and (c) eradication of poverty. It prepares farmers to be agriculture smart on a regular permanent basis rather than ad hoc or transitory to survive the onslaught impact of climate change. The challenge before Agriculture Administration, Agriculture Scientists, Extension Services, Public and Private Agricultural Organizations, and Public leadership is to make this happen. It is an approach for addressing the development efforts towards technical policy and investment condition by mainstreaming agriculture in overall development strategy at local level - village level.

**Climate Smart and Sustainable Agriculture:** Despite adverse climate impact on crops/animals, income to farmers should not decrease. It needs to provide opportunities to farmers to have multiple source of income from agriculture, animal husbandry, fisheries- mulch cattle and poultry. So when one fails, other supports. It provides opportunity to young members of family to acquire multiple skills, support for setting up microenterprise locally based on demand and supply situation, support for setting up protected agriculture and support for farmers on the use of greenhouse technology. It provides safety net at times of natural calamities – by way of crop insurance – for crops and animal husbandry. It provides employment in community projects during lean seasons or at times of drought or whenever needed.



## SESSION SUMMARIES

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Indian Situation: India's success over six decades includes a 2 % to 3% sustainable agriculture growth. Has brought many out of poverty, tackled many adverse climate and geographic challenges, validated research to raise productivity, several states and individual farmers have achieved average productivity higher than or equal to International level. Though unequal growth between agriculture and other sectors like services and manufacturing that have average growth of 8% - 10%. , thereby increasing rural and urban divide. Unequal growth between farmers at local level in same village with similar land and water resources. One makes profit and other fails – commits suicide. Adverse impacts of climate change pushes even successful farmers back to poverty. There is a concern regarding farmer suicides and large scale exodus to urban centers. There are still about 30% farmers below poverty line.

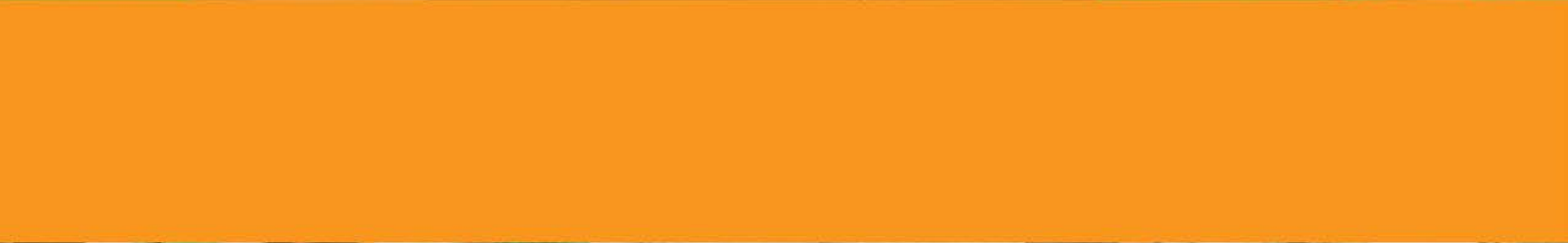
A Knowledge Gap survey was carried out on Indian farmers by the National Council for Climate Change, Sustainable Development and Public Leadership (NCCSD), India in 2013 with the objectives of studying the "knowledge level" among the farmers about the climate smart agriculture based on their level of education, and Identifying gaps. The findings indicated knowledge gaps on average of 56%. Current gaps in productivity between average and optimum point to the lack of effective knowledge transfer to farmers. The challenge to sustainable development is not about lack of knowledge and research. We have all these. But we are not able to transfer this effectively to all farmers, all villages of our country. We are faced with the challenge of a growing gap in productivity between average and optimum production between one farmer and another in the same location with similar conditions. The challenge is to know the reasons for such gaps and to develop implementation strategies to reduce them. Solutions to these problems is the Knowledge Multiplier Hub. To create awareness among farmer communities about the need and the practice of Climate Smart Agriculture. To collect, compile and share knowledge and practice on green livelihoods (agriculture, water,

forestry, fisheries, and energy) and initiate advocacy movement for adaptation on a larger scale. To provide capacity building and skill enhancement training on agriculture based livelihood and climate change mitigation efforts. To generate more sustainable livelihood opportunities for the farmers. To develop best practices and case studies in sustainable livelihood and agriculture. To act as a web based platform for promoting community based locally relevant and environmentally viable technology and knowledge dissemination initiatives.

### **4 Sustainable Corporate Strategies**

This session presented examples of private sector strategies for sustainability in food industries, and the socioeconomic impact of business decisions. The panel analyzed the place of agriculture in global food production and its material impacts on global water and energy use. The speakers found that it is crucial that agriculture is based on sustainable practices. Crop nutrient producers like The Mosaic Company are considered to be a key contributor for helping to promote understanding of the energy-water-food nexus, as our operations are positioned at the beginning of the food supply chain. This is especially important as the world has to produce more food in order to feed larger populations that consume more protein. The Mosaic company outlined its part in ensuring efficient production of crop nutrients, minimizing water and energy footprints and subsequently making sure their products are used responsibly. Their goal is to minimize impacts on the environment and optimize sustainability in the energy-water-food nexus. Although speakers cautioned that climate changes still put additional pressure on all aspects of the nexus, as areas traditionally suitable for agriculture might be more challenged by resulting droughts and floods, the conclusion was to continuously pursue and promote sustainable agriculture and conservation principles.









# SESSION SUMMARIES





# Science Based Policy & Decision Making

*1. Building Sustainable Communities Through New Land use Policies; 2. Every Drop Counts; 3. Zero Hunger - Ideas for Feeding the World; 4. Agricultural Solutions*

## **1 Building Sustainable Communities Through New Land Use Policies**

Summary: This session highlighted effective land use planning and how it leads to opportunities for communities to create compact, mixed-use districts that better address nexus issues. The panel used the Gaines Street, Tallahassee urban development project as a showcase for demonstrating this session. Over a decade ago, the City of Tallahassee, with input from citizens and business owners, developed the outline for a destination district in the heart of Tallahassee; a connection between the two universities and close to downtown that would be the hub of arts and culture in Tallahassee. With this vision in mind, the City adopted the Gaines Street Revitalization Plan. The goal was to create a compact, mixed-use, and multi-modal district that would become a destination for students, alumni, and residents of the city.

The Plan represents a unique and holistic approach to redevelopment. It combines strategic investments in public infrastructure with innovative design guidelines to ensure the development of an environmentally and fiscally efficient district. The Plan was the first such initiative in Tallahassee and has set a precedent for planning within other areas of the city.

Revitalization efforts are paying off for the community. More than \$240 million dollars in new development has taken place on Gaines Street since the start of the project. To date, nearly 1,000 residential units and 250,000 square feet of lodging, retail, and professional

office uses have been constructed within the district and it continues to grow in popularity every day. Based on complementary urban design and street character principles, land development regulations and urban design guidelines the Gaines Street Design Review Districts has served to promote good site planning and appropriate architecture, while encouraging variety and allowing for flexibility in building design. Developers, architects, City staff, and the Urban Design Commission were guided by the principles throughout the design and review processes. Principles of urban design which were implemented in the Gaines Street project include; evoke a sense of place, enrich the public realm, put pedestrians first, build to human scale, fit the neighborhood, frame the street, add rhythm and pattern, and entertain the eye.

## **2 Every Drop Counts**

This session examined the integration of science and public policy in the areas of agriculture and water management. Speakers discussed Direct energy use which stands at 8% fuel component of farm (cost). Indirect energy use: fertilizer from fossil fuels, under pressure Hydrogen turns into NH<sub>4</sub>, 15% cost. Cost motivate producer to conserve more. In 2011-2012 public supply used more water than Agriculture (2.6 billion a day). Water quantity and quality on the farm. Best management practice for water pollution (BMPs) or combination of practices determined by agencies as effective, economic, and improve quality.



## SESSION SUMMARIES

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Florida Department of Agriculture and Consumer Services water restoration act 1999 fund research to verify effectiveness, perform implementation surveys for quality assurance. Nut management, irrigation management, sediment/erosion control, water resources protection, pest mgmt., also may include pasture management.

Proven BMPs include; Soil and tissue testing – fundamental, electronic gauges now available for the producers (NO<sub>3</sub>, Na, K); Spilt application of fertilizer reduces risk of nutrient loss by leaching rain events, more constant N availability ad increase fertilizer. Efficiency, used in strawberries is less than 10% total input loss (Stanley, 2007); Precision application uses photoelectric sensors to measure tree canopy, great for resetting trees in mature citrus groves, fertilizer reduction; Control release fertilizers are standard for container nursery potting, now polymer coated, reduced nitrogen leaching tenfold (Yeager, 2004);, place vegetative buffers and setback landward of water features to treat water, helps terrestrial and aquatic species (EPA, 2007); cover crops trap residual nitrogen, chip potatoes in tri-county area, potatoes, cowpea, green bean rotation can decrease fertilizer (Hutchinson, 2003); Onsite water retention such as wetlands, significant BMP (used in South Florida); Retrofitting center pivots actively converging pivots in North Florida data documented an average water savings per pivot of 35-40% (Suwanee MIL, pre-post audit).

Future BMP Research include bed geometry which are plastic mulch bed (32"), reconfigured to confine roots to a smaller (lateral extent) area to conserve water and facilitate conversion to drip irrigation. Also included are soil test extractant and variable rate irrigation, compatible with center pivots irrigation, shuts off sprinkler nozzles over wetlands, roads, and overlap. Sequestering carbon improving crop production, reducing water, fertilizer use and environmental pollution. Biochar is the product of biomass heating under anoxygenic conditions, mix of solids and liquids. Benefits of sequester carbon include soil quality and productivity, water, fertility conservation, bioenergy

production and waste management. Biochar detractors include scorched earth climate solutions and diversion of, smoke emissions, original soil carbon loss due to biochar, phytotoxicity, recalcetration.

Not much is known about biochar and therefore there is insufficient characterization. Technology of production is key. FAMU has produced some quantity of quality biochar locally and used it effectively. Future goals will be to develop analytical technology to characterize it, investigate the carbon sequestration and also develop cost-effective means of distribution.

### 3 Zero Hunger-Ideas for Feeding the World

Summary: A discussion on how Florida A&M University (FAMU) can play a role in providing sustainable solutions: 90% of the world's farmers are made up by small farmers and who however have not had equal access and participation in programs and trainings designed to assist large producers and agribusiness. With FAMU's linkage to small farmers, they can provide agricultural research and extensions who generally seek out medium and large farmers. Already, FAMU has a State-wide small farm program which is an active participatory capacity building program designed to assist and equip underserved farming populations and their families toward a thriving sustainable development. The Program uses a participatory, multidisciplinary integrated approach to provide relevant education, technical assistance, and hands-on training to underserved farming populations and their communities. It also assists communities with the needs they think are vital for their success. FAMU has been able to encourage sustainable alternative agricultural strategies by working with farmers and their surrounding communities to enable the capacity to thrive and change. As the number of local small farm and garden-farm leaders producing food sustainably using agroecology and organic farming methods continue to grow, FAMU has helped facilitate these efforts and enable farmers provide their produce directly to the community through local markets and community-supported agriculture operations.



The panel also discussed the need for addressing other challenges in community access to healthy food. There is a hidden cost of fast food on health and the environment. Additionally, a large amount of energy and water is lost in the process. Statistics on food access in Florida include; 14.8% Household experience food hardship 2010-2012; 27.6% children experience food insecurity, 2014; 45% Household struggle for basic needs, 2014; 79% Neighborhoods Healthy retailer within ½ mile; 165% increase in FL Household received SNAP, 2007-2012; 3,000,000 People relied on emergency food in 2010

The demand for local food is growing and there is in fact a \$170 million overall value for food in Leon County but most of that money is going outside the county. The Opportunity for food Access in Leon County includes; 22,749 people lived in USDA food desert in 2010; 49,255 people received aid from the Supplementary Nutritional Assistance Program (SNAP), 2012; 3 out of 6 Families accepted SNAP in 2013; there was a 33% increase in the number of families from 2009 to 2013; there was a \$74,583,487.93 value of SNAP redemptions in 2012, and; \$72,000,000 value in local food purchases in 2013.

The Tallahassee Food Network (TFN) offers the "Good Food" Promise: Toward Resilient, Community-based Food Systems to Eliminate Hunger program to help alleviate these issues. The TFN network includes invisible relationships, public and private partnerships which aims at providing community education and asset-based development. The TFN Board & Staff, iGrow, Outreach and Network & Administration to achieve these goals. The program iGrow has helped the community achieve meaningful outcomes which include; growing food, growing leaders, growing capacity; good Food coalition, locally, regionally and hopefully internationally; establish "good food" crop and Dunn Street Community Youth Farm located: 526 Dunn Street. Most of the efforts are voluntary as many volunteer students come from Florida A&M University, Florida State University and Tallahassee Community College. The programs are therefore lead by young people.

International perspectives on food security were also examined. Providing knowledge to local farmers was identified as key to succeeding in this effort. Components of that included; using multiple tools of knowledge economy; focus on local land parcel level information that is directly relevant to small holders in particular; establishing prevailing and optimal output variations; ensuring moisture and nutrient management integration and; establishing alternative livelihood options.

How this applies in India: In 2013, the Government of India introduced a National Food Security Act. The Act provides for food security to both urban and rural poor. Approximately 67% of the country's rural population (810 million people) are entitled to receive subsidized food grain from Public Distribution System. 11 states in India have introduced this scheme. To mitigate some operational issues which arose in the implementation the Indian government introduced a people centred grievance forum through the Lok Adalats (people's courts). They also created legal aid cells to guide the people and even provide a lawyer without any fees for those who cannot afford it. The attention to issues which concern the people will help to secure the cooperation of the community which will in turn help the programs achieve disaster management, climate adaptation, biodiversity and sustainable development. There is also a need to include science and technology in achieving food security as well as the wellbeing of the people. For instance in anticipating natural disasters such as Tsunamis the use of Satellite data has helped mitigate the loss of lives in India. Other technologies discussed by the panel include the use of Integrated Coastal Zone Management systems for securing livelihoods of coastal communities. Recommendations included the launching of scientifically designed seawater farming for coastal area prosperity movement, along coastal areas and small islands. The use of plants for improving livelihoods with seawater farming as one of the areas considering attention. Seawater farming have the potential to enhance food and livelihood security of



## SESSION SUMMARIES

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coastal communities by the cultivation of economically valuable halophytes and salinity tolerant fish species. People-centred coral reef management also were discussed. This would area is already well protected in India under legal provisions of Nations (e.g., Wildlife Act), however, management remains a problem and small scale fishers still dependent on corals for livelihood.

Dealing with climate change by offering knowledge technology would include; technologies for climate resilience in agriculture; best bet practices for dryland farming including agro-forestry and pasture management; ravine reclamation technology packages for salinity and land degradation; ground water recharge mechanisms; best breeds for dairy, fishery and other allied opportunities and; post-harvest processing technology. Finally to promote sustainability include science and the millennium development goals which in India consist of 1.) Eradicating extreme poverty and hunger, 2.) Achieving universal primary education 3.) Promoting gender equality and empowering women, 4.) Reducing child mortality, 5.) Improving maternal health, 6.) Halting and beginning to reverse the spread of HIV/AIDS, malaria and other diseases 7.) Ensuring environmental sustainability, and 8.) Developing a global partnership for development.

### **4** Agricultural Solutions

Summary: Agriculture is the second biggest user of water in Florida. That water is used not only to irrigate crops, but in some instances to protect them from frost and freeze events. Different types of irrigation systems are used on those crops, depending on the type of crop being grown and the local topography and soils. Those irrigation systems vary in efficiency of water distribution and application. In order to maximize water and energy conservation it is important that those systems be designed, constructed, operated, and maintained in such a way that they can perform as much as possible at their unique maximum efficiency. The Florida Department of Agriculture and Consumer Services (FDACS) provides to

the agricultural industry in the State the Mobile Irrigation Laboratory (MIL) and My Florida Farm Weather Programs to maximize that water and energy conservation goal.

The panel also discussed solutions towards the increase in world population as the demand for food grows in the face of future climate change along with decreasing resources of energy, water, and fertilizer for agricultural production. They proposed that one solution to world food production is to increase production in tropical regions where there are large yield gaps that can be met, rather than trying to increase production in developed countries where production is already near its potential. The panel reviewed the University of Florida's experiences in international development to improve crop production and minimize soil degradation in tropical regions that show the need and value of improving crop management practices and transferring improved cultivars to farmers. The University of Florida's involvement in the Agricultural Model Intercomparison and Improvement Project (AgMIP) and a United Kingdom-funded effort that uses crop modeling linked with climate and economic models to evaluate adaptations for improving agricultural production and food security under climate change and climate variability for African and South Asian countries was also presented. These efforts helped evaluate adaptations such as improved cultivars, fertilization, improved management, and residue return, which combined with country-level policy change such as fertilizer subsidy or crop insurance can provide greater food security along with improved economics under present and future climates.



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