TECO Clean Energy Research Center
AT THE UNIVERSITY OF SOUTH FLORIDA

CLEAN ENERGY NEWS

AT THE UNIVERSITY OF SOUTH FLORIDA / FALL '23—SPRING '24

TECO/USF Partnership Strong with CERC Renaming and Creation of Steering Committee

USF and TECO event on April 26, 2024—Photo courtesy of Ryan Wakefield

By Stephanie Washington

The University of South Florida and Tampa Electric (TECO) have a partnership that dates back to 1974. In recent years TECO has partnered directly with the USF Clean Energy Research Center (CERC) supporting research and innovation in renewable and clean energy. In honor of that partnership, on April 26, USF announced that the Clean Energy Research Center would now be called the TECO Clean Energy Research Center.

The renaming of CERC is the latest expression of USF's ongoing partnership with TECO, but another important aspect of their partnership

Continued Page 4

USF Solar Energy Society Events Promote Clean Energy

By Stephanie Washington

The USF Solar Energy Society (SES) hosted several lectures over the Fall 2023 and Spring 2024 Semesters promoting clean energy. These events consisted of lectures from guest speakers followed by a question-and-answer period.

The first event was held on Nov. 9th. SES hosted a lecture by Dr. Wojciech Lipiński titled *Revolutionaries Tomorrow's Energy Landscape with Concentrated Solar Thermal Energy*. Dr. Lipiński is a Professor at the Cyprus Institute, Editor-in-Chief of

Continued Page 2

Inside this issue:

Special points of interest:

- CERC renaming and steering committee
- SES Fall & Spring Lectures
- $50K Donation to CERC

USF Solar Energy Society continued from page 1

Thermopedia,

and Associate Editor of Solar Energy and the Journal of Quantitative Spectroscopy and Radiative Transfer. His lecture covered the impact of solar thermal energy and how important it is for sustainability in the future.

The second event, *Shaping the Future: Renewable Energy Insights from Industry Experts*, was held on Nov. 16th, 2023. Representatives from TECO, Shelly Whitworth and Julie Chilson, gave a presentation on TECO's progress in solar energy over the past few decades, both are USF alumni with degrees in Environmental Engineering and Mechanical Engineering respectively. Shelly Whitworth is a program manager with Marketing & Program Development and Julie Chilson is a Senior engineer and has been with TECO for 17 years.

Ms. Whitworth and Ms. Chilson gave a presentation on TECO's increased solar energy presence, detailing how TECO finds land and develops it into solar plants. They shared information on new technology and innovations that TECO is exploring and how they are solving problems such as land scarcity with floating solar and working with farmers to integrate solar into crops. Attendees to this lecture got an in-depth look into TECO's plans for clean, renewable energy.

The first lecture of 2024, was *Explore the Promising Future of Biofuels* given by Dr. George Philippidis, the Associate Dean of Research and Director of the Sustainable Energy concentration at the University of South Florida's Patel College of Global Sustainability (PCGS). This lecture was held on January 25th and addressed topics such as bioethanol derived from corn or sugar cane and how the future of biofuels is moving away from fuels derived from food sources with new advances with different plants like Brassica Carinata.

From left to right: Rajat Mittal, Yasser Mirza Baig, Fernanda Pimenta, Dr. D. Yogi Goswami, Shelly Whitworth, Julie Chilson, and Shreyash Dinkar Bhadirke at USF Solar Energy Society *Shaping the Future: Renewable Energy Insights From Industry Experts* talk held on Nov. 16, 2023

On February 22, 2024, SES held a Lunch & Learn featuring Dr. Kebreab Ghebremichael, who is Professor of Instruction at the Patel College of Global Sustainability. The lecture titled *Getting to Net Zero GHG Emissions in Florida* took a deep dive into how greenhouse gas (GHG) emissions are measured nationwide and in Florida and what could be done to reduce them. Dr. Ghebremichael showed the sectors that produced the largest emissions and scenarios for a future where no changes were made to how we produce GHGs versus making changes to reach net zero by 2050.

Any students interested in joining SES or attending future events are encouraged to visit their website: https://bullsconnect.usf.edu/ses/solar-energy-society-/

And, follow them on social media @ses.usf on Instagram and LinkedIn at https://www.linkedin.com/in/solar-energy-society/

CERC Receives Philanthropic Gift from Local Couple

By Stephanie Washington

The Clean Energy Research Center (CERC) received a gift of $50,000 from Jack Russo and Dr. Leigh Soutter. Mr. Russo is a corporate attorney and managing partner with Computerlaw Group LLP, and Dr. Soutter is Vice President at Florence Venture Partners in Silicon Valley, CA.

The couple first learned about CERC from the director, Dr. D. Yogi Goswami and his wife Lovely Goswami, when they became neighbors. It was after Dr. Goswami and his wife reached out to welcome them to their neighborhood that they connected based on their mutual interest in entrepreneurship and innovation.

Recently Dr. Goswami invited Mr. Russo to guest lecture for his ECH 4680 Product Development class, where he shared valuable information about intellectual property litigation and other areas of his expertise. As part of their visit to USF, Dr. Goswami gave Mr. Russo and Dr. Soutter a tour of the CERC lab and the Solar Field.

After the tour, I sat down with Mr. Russo and Dr. Soutter and discussed their generous donation to CERC. While it has not been decided precisely how the funds will be spent Mr. Russo is confident that they will be put to good use. I asked what he hoped these funds would help CERC accomplish.

"I just trust Yogi and Lovely to use the money in a very smart way." Mr. Russo responded.

Mr. Russo and Dr. Soutter have a history of donating to prestigious universities; they donated to the Stanford University Artificial Intelligence Lab (SAIL). Mr. Russo talked about the importance of

From left to right: Jack Russo, Dr. Leigh Soutter, Lovely Goswami, Dr. D. Yogi Goswami in Dr. Goswami's office in USF Engineering Building II.

Artificial Intelligence applications in the future. And went on to describe how some of the donated funds could help expand the course Dr. Goswami is currently teaching.

"... the version of this course that [Dr. Goswami is] currently teaching but with the flip of it's all about AI applications of the future, which is modeling the course that we provided support to at Stanford." Mr. Russo said. "The kids that are in those classes come up with such interesting out-of-the-box ideas of how to use AI to make more friction-free ways for people to connect."

They hope that the donation funds can help students take what they learn in class and apply their ideas to real-world problems and create solutions. One example where students are already doing this is the CERC Solar Field.

"It's very exciting to see people be able to take their ideas and put them into some kind of practice...and it's bettering the community and the world." Dr. Soutter commented about the Solar Field.

Another key element of this suggested course would have students learn how to pitch their ideas in a tournament-style competition which would end with a final round where students would pitch their ideas to investors. Mr. Russo believes that pitching is an important skill students can take into the workplace and a necessary part of project management.

CERC is grateful to Mr. Russo and Dr. Soutter for their donation. Anyone wishing to donate to CERC can do so by going to the USF Foundation website at https://giving.usf.edu/online/ and searching for Clean Energy Research Center in the search bar for more information.

TECO/USF continued from page 1

has been the creation of a steering committee. The steering committee is made up of TECO business professionals and USF faculty. They meet once a month to discuss their mutual interest in clean energy technology and research. TECO is interested in renewable clean energy and by partnering with USF they can understand what innovations and research are being developed in this field. In the spirit of sharing information TECO has conducted seminars on USF's campus to present their advances in solar energy and USF professors have presented their research to the steering committee.

Dr. D. Yogi Goswami at the TECO CERC naming event on April 26, 2024—photo courtesy

Dr. Lingling Fan and Dr. Arman Sargolzaei both gave presentations to the steering committee outlining their research. Dr. Fan is a member of the steering committee and a professor in the USF Department of Electrical Engineering. Dr. Fan's presentation outlined the USF Smart Grid Power System (SPS) Lab's research and highlighted their sponsored projects. The SPS Lab was founded in 2011 and in the past ten years, the lab has conducted research projects sponsored by the US Department of Energy, National Science Foundation, Electric Power Research Institute, and many other organizations. Dr. Arman Sargolzaei is an assistant professor with Mechanical Engineering and Director of the Resilient, Autonomous, Networked Control Systems (RANCS) Lab and is also a member of the steering committee. At the January meeting, Dr. Sargolzaei gave a presentation on the latest research conducted by the RANCS lab. The presentation outlined some of the lab's recent advancements in electric vehicle (EV) technology. Dr. Sargolzaei presented on many aspects of the lab's work such as the technology that will optimize charging times, the benefits of smart apps, and ways they can address cost saving. Solar-based mobile charging stations and National Electric Vehicle Infrastructure were also among the topics Dr. Sargolzaei presented to the committee.

On the TECO side of the steering committee there is Jordan Ekhlassi, the Manager of Energy Storage Projects and Clean Energy, and Kris Stryker the Vice President of Clean Energy & Emerging Technologies. Jordan Ekhlassi is the committee chair. As the leader of the committee, he helps bring both sides together in this mutually beneficial partnership. "The renewable energy industry has changed so much and will continue to evolve. Having these connections with USF gives TECO more insight to what's coming and what's possible," Mr. Ekhlassi said. It is easy to imagine how the future of clean energy in Tampa will benefit from the TECO – CERC partnership. And that partnership is not necessarily limited to research professionals at USF. As a USF Alumni, Mr. Ekhlassi understands how important having a connection to higher education can be for industry partners like TECO. "This collaboration can prepare USF students for a career in energy and help meet TECO's workforce needs," he said.

Mr. Stryker also expressed his support for TECO's partnership with USF and had this to say, "Tampa Electric has partnered with USF in many ways over the past 50 years, and we're especially pleased to be connected with CERC because of all the mutual benefits. Since 2000, Tampa Electric has slashed sulfur dioxide and nitrogen oxide emissions by at least 96 percent and cut carbon dioxide emissions by more than 56 percent – even while the demand for power increased by 25 percent. We also have the highest percentage of solar generating capacity of all Florida utilities. With accomplishments like these comes extensive experience deploying new technologies. That means the TECO team can offer USF students a deep understanding of the practical challenges that we face in the energy industry - and ways they can help. That dialogue can also increase students' awareness of the dynamic nature of this field and its potential career opportunities. We're excited for the ideas, research, and practical solutions that USF researchers can offer to Tampa Electric as we continue working to safely deliver power that is reliable, affordable, and sustainable – now and into the future."

CERC Alumni Updates

Left: Proud father Phil Myers with his daughter Louisa Kristine Myers (also pictured right) - photos courtesy of Phil Myers

A New Addition to the CERC Family

Former CERC Research Associate Phil Myers, Ph.D., P.E. received a welcomed addition to his family this past autumn. Louisa Kristine Myers was born on October 9th, 2023. Dr. Myers currently works for the U.S. Environmental Protection Agency in Denver, CO.

First photo: Tanvir Alam; Second photo: Rajeev Kamal (Left), Francesca Moloney (right) - photos courtesy of Francesca Moloney

USF Alumni at NextEra Energy

Francesca Moloney Ph.D., Tanvir Alam Ph.D., MSME, and Rajeev Kamal Ph.D., MBA, PMP, CEM are among over a hundred USF alumni who work at NextEra Energy, Inc., according to LinkedIn. Notably, all three are CERC alumni, as well. NextEra Energy is the world's largest renewable energy generator from wind and sun. Rajeev Kamal is a Project Manager, Tanvir Alam is an Engineering Manager, and Francesca Moloney is a Principal Engineer.

Rachana Vidhi Ph.D., holding her son Kushagra - photo courtesy of Rachana Vidhi

Future Hall of Famer

Former CERC research assistant Rachana Vidhi, Ph.D. will be inducted into the Florida Inventors Hall of Fame on Friday, October 25, 2024. Dr. Vidhi has a Ph.D. in Chemical Engineering from USF and is currently the Director of Sales Engineering at NextEra Analytics, Inc. CERC congratulates Dr. Vidhi on being nominated to the Florida Inventors Hall of Fame. She is one of nine nominees selected for induction this year.

Latest from CERC

Standing Left to Right: Brian C. Gray, John N Kuhn, Rarosue Jennifer Amaraibi, Babu Joseph; Kneeling: Current PhD student Olusola Johnson - photo courtesy of John N Kuhn

Recent Department Graudates

By John N Kuhn

Rarosue Jennifer Amaraibi and Brian C. Gray both completed PhDs in Spring 2024 after conducting research on a Department of Energy project "Intensified Biogas Conversion to Value-added Fuels and Chemicals" at USF. This project focused on enabling small scale chemical upgrading of methane containing waste gas to much needed renewable fuels and chemicals. Both were advised by Professor John N Kuhn and Babu Joseph. Brian has started as a project engineer at Catalent in St. Petersburg and Rarosue will be conducting research at the National Renewable Energy Laboratory starting later this summer.

RANCS Lab Aims to Maximize Energy Recapture in Electric Vehicles

Resilient, Autonomous, Networked Control System (RANCS) Lab vehicles - Photo courtesy of Dr. Arman Sargolzaei

By Dr.Arman Sargolzaei

The Resilient, Autonomous, Networked Control System (RANCS) Lab aims to design, implement, and verify control and communication systems for safety-critical cyber-physical systems. RANCS focuses on Networked Controlled Systems, which find applications in transportation systems, power systems, and biomedical systems. By addressing the unique challenges of these sectors, RANCS advances the state-of-the-art in ensuring safety and robustness in critical infrastructure. A particular emphasis is placed on electric connected and autonomous vehicles (CAVs), where safety, security, and energy efficiency are paramount. RANCS's innovative research is directed towards overcoming the hurdles faced by these systems, contributing to the broader adoption and effectiveness of CAVs in modern society.

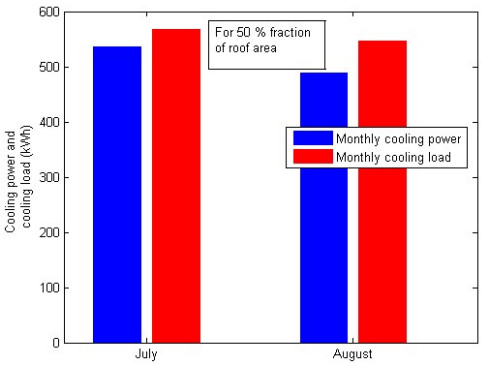
One of the latest projects at RANCS Lab is Eco-Regen, which aims to maximize the energy recaptured by electric vehicles (EVs) through a novel regenerative braking system. As cities transition to sustainable transportation, EVs are crucial for reducing emissions and fossil fuel dependency. However, challenges such as cost, range limitations, and driver training impede widespread adoption. Although EVs are more efficient than conventional vehicles, their regenerative braking systems (RBS) need improvement. To address this, RANCS developed a novel control strategy and mechanical modifications, including a gear shift, autonomy integration, and a three-phase power inverter. The connected RBS, Eco-Regen, enhances energy efficiency and range, making EVs more viable for applications like platooning and traffic stops. This innovation represents a significant step towards more sustainable urban transportation systems.

Development of a Paint for Buildings that Cools Itself by Radiating Heat to the Deep Space

By Dr. D. Yogi Goswami

In 2020, cooling of buildings around the world consumed 36% of the total energy, which was responsible for 37% of the energy related CO_2 emissions in the world[1]. Therefore, in order to achieve "Net-Zero" carbon emissions, decarbonizing the building cooling sector will play a major role. Cooling of buildings normally depends on "Vapor Compression" refrigeration systems, which require a large amount of electric power. Over the years, research in refrigeration technology has increased the cooling efficiency which has helped; however, we are reaching the limits of how much we can improve in that direction. In very dry places, such as Arizona, evaporative cooling can also be used, in which water is evaporated to cool the environment. However, the method uses water, which is scarce in the desert areas. For humid areas, desiccant air conditioning could also be used. Principles of Solar Engineering, 4th edition[2] describes these methods in detail. All the energy efficient methods have helped; however, cooling of buildings still uses a large amount of energy and is therefore responsible for a major portion of the global carbon emissions. So, in our research, we must look into methods that will provide cooling with "little or no energy use". These methods use natural forces to provide cooling and are also called "Passive Cooling". At USF CERC, we have ongoing research in passive cooling that will provide comfort cooling with very small amount of electrical power that could come from the Sun or no power at all. Below is just a glimpse of that research and we hope to give you progress in that direction from time to time in this newsletter.

Passive radiative cooling has been used in older civilizations for many centuries. Anecdotal information is available about using nighttime cooler sky temperatures to cool water and to even produce ice when the ambient temperatures were much higher than freezing temperature. These past passive cooling methods were mainly based on lower nighttime effective sky temperatures for radiative cooling. However, developments over the last few years have pointed to passive daytime and nighttime cooling utilizing deep space as the heat sink under certain conditions3. This is possible because the atmosphere is quite transparent to thermal radiation between the wavelengths of 8 μm and 13 μm. Therefore, this wavelength range is known as the **atmospheric window**. If a selective surface is designed to emit highly in the atmospheric window, it will exchange radiative heat with deep space, which is at a temperature close to absolute zero. However, for daytime cooling solar irradiation must be reflected to be able to achieve a reasonable amount of cooling. An ideal radiative cooling structure should have emittance/absorptance close to zero in the solar wavelength range and close to one in the atmospheric window.



Monthly cooling load and radiative cooling power for 50 % of roof area covered with radiative cooler for climatic conditions of Miami

Researchers at Stanford University[3] designed a surface with close to ideal properties in 2014 and placed that surface on the roof of a building on campus facing the Sun on a clear day. They found that the surface temperature, instead of going up as one would expect, went down by about 50C, which proved the concept of what we call "Plasmonic Cooling". However, the way they created the surface would be too expensive for practical applications. A practical and commercially viable method would be to create a coating that could be applied to the walls and roof of a building as paint, even if it requires a number of layers.

Since the demonstration by researchers at Stanford University, a number of researchers around the world have been trying to create such a coating. A research group at USF CERC has also been busy developing such a coating for the last 2 years. Our theoretical research has shown that it is possible for us to create a coating with the right properties, which requires close to perfect reflection in the solar wavelength range (0.3 microns to about 3 microns) and close to perfect emission in the Atmospheric Window (wavelength 8 microns to 13 microns). We will present some results in the next CERC Newsletter. If we achieve the results predicted by the theoretical research, our simulation shows that for a well insulated 1850 square feet brick residential building in Miami, if we cover only 50% of the roof area with the plasmonic emission coating, the natural cooling will provide most of the cooling load of the building[4]. We can't predict when we will achieve success in our efforts, but the potential benefit is the motivation for us to continue our research.

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CLEAN ENERGY IS GREEN ENERGY

Florida has no sustainable indigenous supply of fossil fuels but we do have solar and biomass resources. The Clean Energy Research Center (CERC) at the University of South Florida pursues research and development of new and environmentally clean energy systems. See our website for a complete listing of our research, patents, and publications: cerc.eng.usf.edu

KEY RESEARCH PROJECTS

- Environmentally clean energy systems
- Solar thermal power
- Photovoltaics
- Concentrating solar power
- Energy storage (phase change materials, thermal storage, batteries, supercapacitors)
- Photocatalytic detoxification/disinfection technologies
- Smart materials (Thermochromics and electrochromics)
- New efficient thermodynamics cycles
- Solar energy conversation via rectifying antennae
- Biomass conversion/biofuels
- Solar water desalination and distillation
- Design of solar plants on reclaimed land

CERC DIRECTOR

Dr. Yogi Goswami is a Distinguished University Professor and Director of the Clean Energy Research at USF, as well as Editor-in-Chief Emeritus of the *Solar Energy* journal and Editor-in-Chief of *Solar Compass.* A member of the Florida Inventors Hall of Fame, he has more than 40 years of experience in education, research, entrepreneurship, leadership and policy development.
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CERC Founder

Dr. Elias K. Stefanakos, is a USF professor emeritus and former CERC Director. His focus was on research and development related to renewable energy sources and systems, such as concentrated solar power systems, Smart materials (thermochromics and electrochromics) and photovoltaic energy.

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