

# Motivated to innovate

Preserving nature, providing water to thirsty communities, and meeting power demand with new technologies are all goals of four Clean Energy Research Center doctoral students finishing up their research here at USF this year. And whether their paths started in India, Saudi Arabia, Bangladesh or New York, a sense of responsibility led them here to innovate.

Here are their stories:



## **Eydhah Almatrafi**

“Water is life,” says Eydhah Almatrafi, 32, a faculty member of the college of engineering at the King Abdulaziz University in Saudi Arabia who came to USF to research solar desalination. He wants to help meet the high demand for fresh water in the world, especially in the Middle East and North Africa.

His key learning from USF? “Think global, act local.”

Eydhah worked at ARAMCO and SABIC oil companies in Saudi Arabia before winning a fellowship that changed his path from industry to academia. He has a bachelor’s from King Fahd University of Petroleum and Minerals in Dhahran, Saudi Arabia, and a master’s from George Washington University in Washington, D.C. He is

now completing a doctorate; all of his degrees have been in mechanical engineering.

As he finds that desalination research is gaining importance, Eydhah is focusing on solar desalination systems, membrane desalination, thermal desalination, and the supercritical-organic Rankine cycle, which is getting more attention in the area of low-grade heat source power generation. He is studying coupling a supercritical-organic Rankine cycle to multi-effects desalination assisted by a mechanical vapor compressor, which lowers specific thermal power consumption.



His most memorable experiences at the university include participating in USF graduate research day and four international conferences on engineering and energy.

He plans to fulfill his mission to “act local” by next teaching courses in thermodynamics, heat transfer, designing solar power plants and desalination at King Abdulaziz University as well as leading the solar-desalination program in Saudi Arabia by working at a desalination research center.



### **Francesca Moloney**

Francesca Moloney, 26, is interested in renewable energy because “I love the great outdoors.”

“I know renewable energy is the future to protect the beauty that surrounds us,” she says.

Francesca was born in Massachusetts but grew up in upstate New York. She has a bachelor’s in civil engineering from Florida Gulf Coast University and has been working on a doctorate in mechanical engineering at USF since 2014.

Her research has focused on creating a hybrid system with solar thermal and geothermal energy with thermal energy storage while using innovative thermodynamic cycle configurations to enhance power output.

At USF, “Most of the time, research never goes as expected. It is an adventure, but a rewarding one,” she said.

She found that a low temperature source, such as geothermal energy, can be effectively integrated into a power cycle operating from a higher temperature source, such as solar thermal energy. Thermal energy storage extends the availability of a high temperature source to convert power in a more efficient power cycle at a higher capacity rather than relying on only geothermal energy and a lower efficiency and lower work output cycle.



Now in the final stages of her doctoral research, Francesca has already accepted a position as a distribution engineer in Fort Myers at Enercon, a company specializing in energy design and planning projects. She ultimately would like to help expand renewable energy to enhance efficiency and implementation.

At USF, “I enjoyed collaborating on various research projects with my colleagues at CERC. Everyone is very bright and comes from a different background, which was exciting to work with. I learned very much from them.

“I also had the opportunity to share my work at middle and high schools and teach students about graduate school,” she added. “It was amazing working with these motivated students and helping them to think about the future in terms of energy usage and their personal career and education goals.

She added: “What motivates me is that although my research cannot make us rely solely on renewable energy, it is one piece of the puzzle in reducing and eliminating global carbon dioxide emissions. I believe we can achieve net zero emissions, and I want to be part of that transformation.”

### **Arun Kumar Narasimhan**



Arun Kumar Narasimhan wants to help meet the demand for electricity in rural areas of developing countries. About 1.3 billion people around the world are without electricity, he noted, and 90 percent of that number are from India and sub-Saharan African countries. His rural hometown in southern India had frequent power outages, and he put solar panels on his family’s rooftop to power the home. But not everyone in his town could afford this, he said, and he wanted to help find a way toward grid independence in rural areas.

“I want to work on addressing societal problems like rural electrification and reducing our carbon footprint through sustainable practices,” he said.

Arun, 30, moved to the United States in 2013 to further his studies. He has a bachelor’s degree in chemical engineering from SSN College of Engineering and a master’s degree in energy and environmental engineering from VIT University.

He is working with thermodynamic cycles and small-scale power generation, and is receiving his doctoral degree at USF in chemical engineering.

At CERC, he has been designing scroll expanders that convert solar heat to power



and mapping their performance for small-scale power generation (less than 50 kilowatts), which is more suitable for localized electricity in rural areas that have higher solar resource availability due to their latitude.

Scroll expanders are more suited and efficient for small-scale power generation than other types of expanders and turbines. Certain working fluids allow compact design of scroll expanders, thereby reducing the leakage and improving the overall performance, he said.

Arun is searching for jobs in corporate research and academia, particularly in the areas of small-scale power generation and building energy modeling and efficiency.

His most memorable experience at USF was “fascinating lectures that taught me how to teach”

and “reducing the carbon footprint of the campus through sustainable projects” such as installing LEDs at BSF, streetlights in parking lots, and a 400-kW solar PV power plant at the Marshall Center, he said.

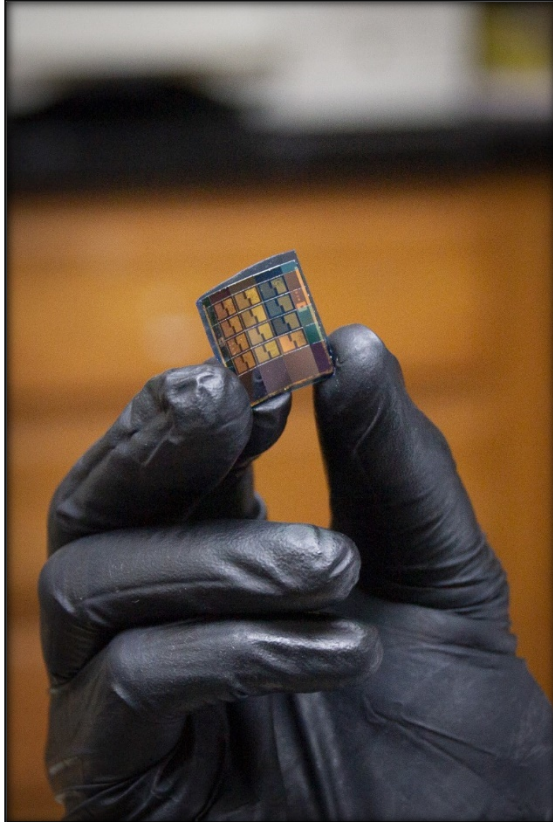
At USF he learned how to address and solve a research problem, to communicate and present ideas clearly, as well as improve his research writing techniques. He is motivated by “solving research problems and challenging work.”

## Ibrahim Azad

From taking apart remote controls to finding the magnets inside motors as a child in Bangladesh, Ibrahim Azad has always been interested in smaller devices. Now Ibrahim, 33, has a chance to broaden his scope with his research on micro/nano devices.

Ibrahim is from Dhaka, the capital of Bangladesh, and has a bachelor's and master's in applied physics, electronics, and communication engineering from the University of Dhaka. He came to USF in 2014 to work on a doctorate in electrical engineering. He and his wife are expecting their first child this summer as he completes his dissertation and searches for jobs that will allow him to work on improving micro/nano devices that are important for applications such as infrared sensing and





solar energy harvesting.

“When I started my science learning, I was eager to know how things work, and my questions about electronic things pushed me to learn more about electrical engineering,” he says.

One device he has been working on is the antenna coupled diode rectifier (rectenna). One of the major applications for the rectenna is energy harvesting, which is generating clean energy from surrounding electromagnetic waves. Ibrahim found the rectenna could be the new technology for infrared detection that can address issues with current technologies. But, he says, there is still “lots of room to work on rectennae.”

His most valuable experiences at USF included discussing his work with friends and colleagues where “I learned how to be patient in your tough times.”

He plans to work in research and development in the United States for a few years and then take his expertise back home

to guide engineering research in a university in Bangladesh, where he was previously a junior lecturer and where he said expertise is greatly needed because it is a developing country.

“I want to work in an environment where I can contribute to improve new technologies for future generations,” Ibrahim said.