

U.S.-PAKISTAN CENTERS FOR ADVANCED STUDIES IN ENERGY

ENERGIZER

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This USPCAS-E scholar wants all Pakistanis to have 24/7 access to energy.

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TURNING LOSS TO GAIN

One USPCAS-E applied research project has resulted in energy-saving equipment that's likely to deliver considerable savings to a biscuit manufacturer in Pakistan.



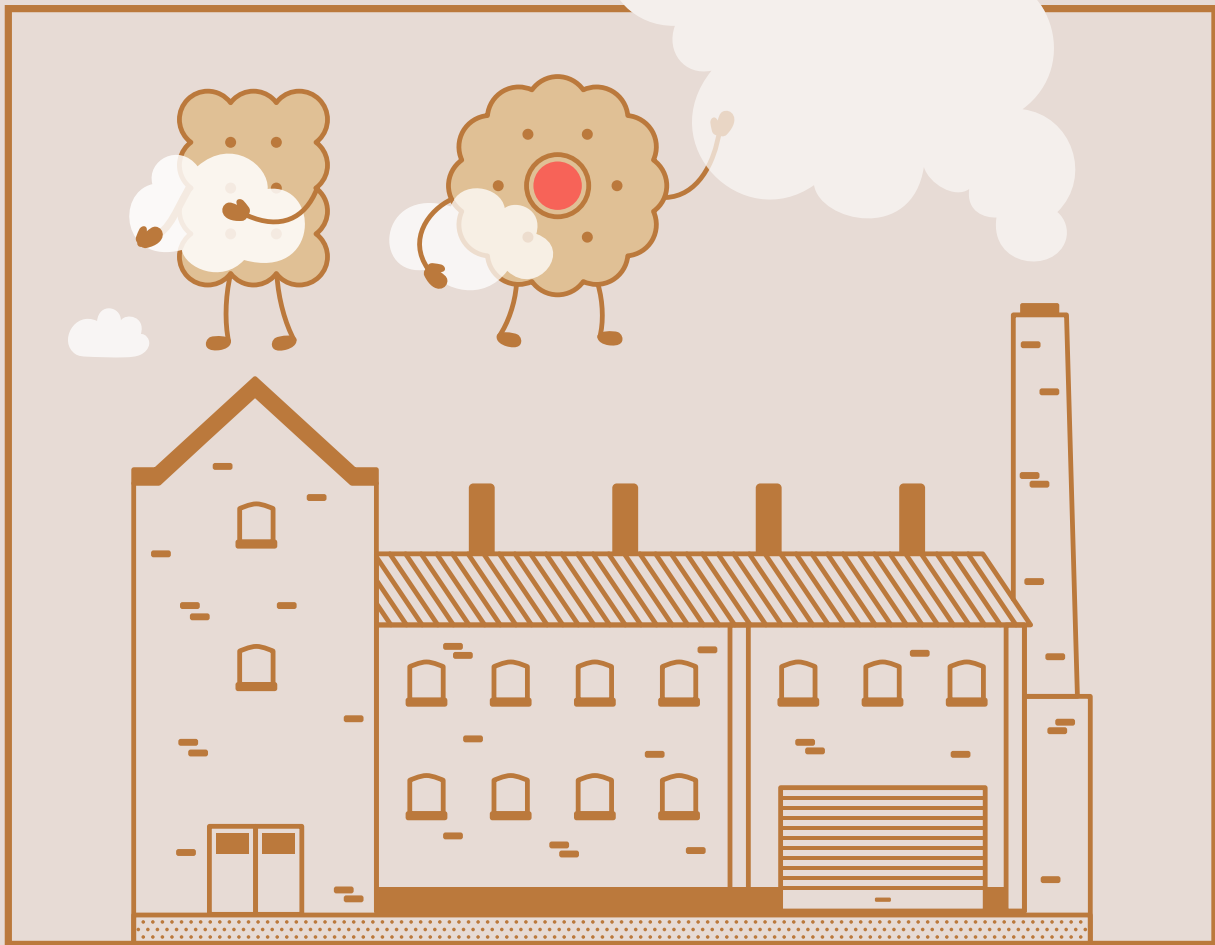
USAID
FROM THE AMERICAN PEOPLE

ASU Arizona State University



TURNING LOSS GAIN

in cookie-factory
baking facilities



Illustrations by Qiudi Zhang

It's been 66 years since former General Motors president Charles E. Wilson was misquoted as saying "What's good for General Motors is good for the country." The line took off because it's easy to extrapolate national benefit from corporate success. If industry can increase profitability and operate equipment in a greener way, such benefits also impact society at large.

That's the hope behind recent research conducted by the U.S.-Pakistan Centers for Advanced Studies in Energy (USPCAS-E). An applied research project has resulted in energy-saving equipment that's likely to deliver considerable savings to Pakistan-based Coronet Foods, a subsidiary of English Biscuit Manufacturers.

KEEPING ENERGY FROM GOING UP IN SMOKE

Natural gas prices have skyrocketed in Pakistan. This past September, Pakistan's Economic Coordination Committee (ECC) approved a 57 percent increase in gas prices for the commercial sector. General industry saw a 40 percent increase and the power sector took a 57 percent hike.

"Industry will be hit squarely," says Ahmed Sohail Khan, the USPCAS-E technical advisor with the University of Engineering and Technology (UET), Peshawar. "Gas prices have more than doubled in recent months."

That's bad news for bakeries like Coronet Foods, which relies on gas for production.

"Coronet Foods is one of the largest biscuit producers in Pakistan and our production mainly depends on gas," says Asif Sultan, a professional engineer and principal investigator on a joint research project with USPCAS-E. "The share of gas in our utility bill is 80 percent in terms of monetary value."

Due to limited resources and the low pressure of natural gas, Sultan says Coronet uses a combination of natural gas and liquified petroleum gas (LPG) to fulfill plant requirements. Those requirements necessitate an average monthly consumption of around 27,33,72 cubic meters, of which 70 percent is LPG and 30 percent is natural gas.

Sultan adds, "We require a huge amount of hot water in different areas of production processes like mixing areas, washing areas and kitchens. Our hot water requirement is around 200 gallons per hour, and we are using gas geysers (water heaters) for this operation. These gas geysers are adding a huge amount to our utility bill."

Worse, much of that money is essentially drifting up the flues of baking ovens.

"For most fuel-fired equipment, a large amount of the heat supplied is wasted as exhaust or flue gasses," notes Saim Saher, an assistant professor of engineering at UET Peshawar. "These gasses still hold considerable thermal energy. In many systems, this is the greatest single loss of heat."

But, Saher continues, the loss can be mitigated.

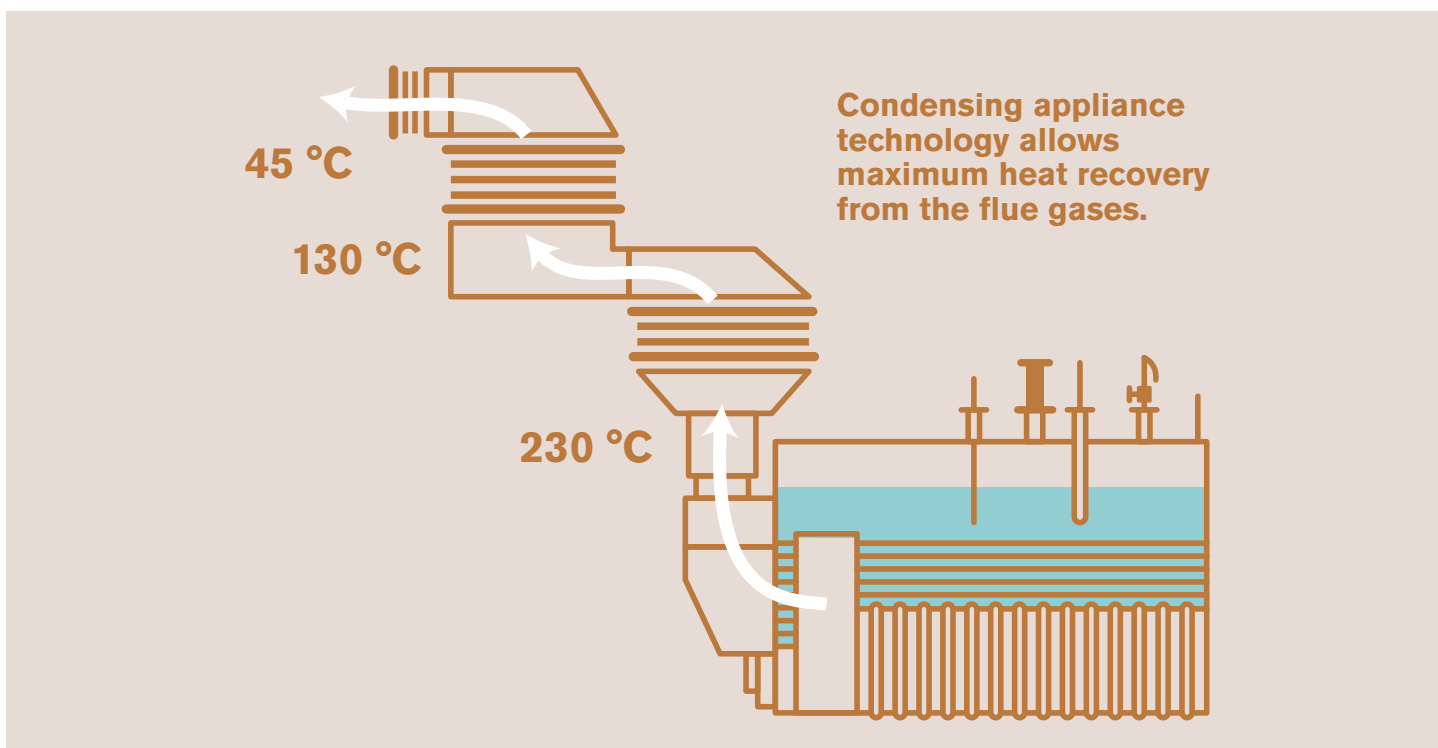
"The energy efficiency can often be increased by using waste heat gas recovery systems to capture and use some of the energy in the flue gas."

Working with Saher and some of his students, Coronet Foods has been developing a heat-recovery system.

"THE PRIMARY AIM OF THE RESEARCH WAS TO DESIGN AND CONSTRUCT A SYSTEM THAT WILL RECOVER 70 PERCENT OF WASTE HEAT ENERGY FROM NATURAL GAS FURNACE OVENS AND MAKE IT USABLE FOR WATER HEATING PURPOSES. CURRENTLY, WE ARE WASTING THIS ENERGY (BY RELEASING IT) INTO THE ENVIRONMENT."

— ASIF SULTAN





INDUSTRY DRIVEN, ACADEMIA SUPPORTED

"This is basically an industry-driven project," says Saher. "The principal investigator, Asif Sultan, came up with the idea and we discussed it before developing the proposal."

To support the research project, Saher advertised a student job and hired Yaseen Mehmood, a graduate scholar and mechanical engineer. He designed the device that would be used in the waste-heat recovery system and worked with Sultan to finalize and approve the design.

"The company management is very encouraging in terms of innovation," Sultan says. "When I came up with this idea, there was no resistance from approving authorities and, in fact, they motivated me to pursue the project."

Part of the payback of this project comes from strengthened bonds between industry and academia.

He adds that there were frequent exchange visits between Sultan and the scholars, where each visited the other's site, a move that proved to be a strong relationship builder.

"Normally, the private sector does not trust the capabilities of academia to provide design solutions," explained Saher. "This project has boosted trust."

In addition, it served as a showcase for industry leaders to discover the benefits of academic research.

"Most factories in the country are using their regular production processes and not considering energy conservation or efficiency," Saher says. "This is a unique approach in Pakistan, particularly when we talk about the food industry."

The team hopes to showcase the finished project to other bakeries and spread this efficiency measure nationwide.

OUTSMARTING SULFUR

Cookie-baking ovens can reach temperatures as high as 250 degrees Celsius or 482 degrees Fahrenheit. The heat-recovery equipment extracts much of the heat and discharges gasses at 75 degrees Celsius or 167 degrees Fahrenheit.

"Whenever you extract heat below 100 degrees Celsius there is condensation and sulfur dioxide in the flue gasses, and this could corrode the equipment," says Khan.

This has been one of the challenges of the project.

To combat this, the UET Peshawar researchers leveraged materials science along with engineering in designing the equipment. The prototype unit was designed with stainless steel because it is resistant to corrosion, allowing the team to cool flue gases more completely and capture more of the thermal energy.



"The lower the flue gas temperature can be reduced, the more efficient the condensing appliance technology," notes a report produced by the research team.

Right now, the team is testing a second version of the heat-recovery device because moisture was getting trapped inside the first unit.

"We have redesigned the model based on testing and are currently fabricating a new product," Saher says.

He says this time the team created a condensing economizer, a device that removes heat from hot flue gases by passing them through coiled pipes.

"Once complete, we plan to replicate this with the baking industry across Pakistan," he adds. "We will invite representatives of industry to visit the factory and see results of our project"

The results should be impressive. Currently, Coronet Foods invests 1,211,760 Pakistani rupees or nearly \$9,000 per month in natural gas and LPG for water heating only.

"After installation of the heat recovery system, we save every month," Sultan says.

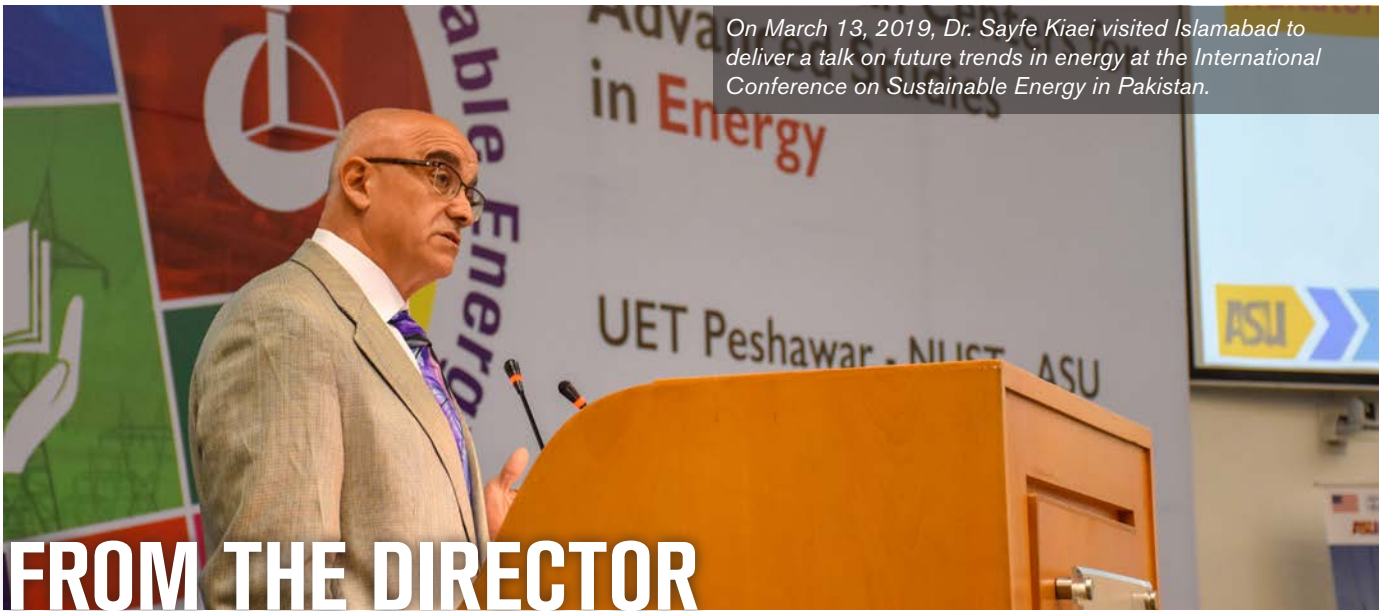
Even if the final heat-recovery system only operates at 40 percent efficiency, it is likely to recover system costs in less than one year. And, because it was a joint research project with UET Peshawar, the benefits can spread throughout Pakistan.

"If companies are implementing different cost-effective solutions, they are not disseminating these practices to a larger audience," Saher says. "Our project seeks to benefit other players in the market by sharing our findings and results."

In fact, the project may go beyond bakery ovens and wind up benefiting many businesses in Pakistan. Khan also envisions this type of condensing economizer being used in five-star hotels in the country's northern mountains.

"There is no natural gas because there is no pipeline for these areas," he says. "They operate boilers with diesel, and that has a heavy sulfur content. This design holds enormous potential for industry."

BY BETSY LOEFF



On March 13, 2019, Dr. Sayfe Kiaei visited Islamabad to deliver a talk on future trends in energy at the International Conference on Sustainable Energy in Pakistan.

FROM THE DIRECTOR

It's full speed ahead for USPCAS-E! Pedagogy training continued this quarter providing USPCAS-E faculty with the latest tools to create the best possible learning environments for our students. USPCAS-E hosted its first international conference in March—another significant milestone. More than 550 attendees met for two days to discuss pressing issues and opportunities in renewable energy.

On the heels of the conference, USPCAS-E hosted a multi-day leadership training for faculty and staff at both centers. These hands-on sessions led by ASU Professor Dan Shunk provided a critical opportunity for center leaders to work together to create meaningful and actionable strategic plans that will help carry the centers forward after the funded project concludes later this year.

In May, our last cohort of exchange scholars will head home to Pakistan. The exchange program is one of the major successes of this project and we have exceeded our project target of 200 exchange visitors—which was actually a revision to the original target of 100! Many of the exchange scholars have said that the opportunity to work in U.S. university labs and learn more about U.S. culture first-hand is transformational. We hope that these experiences will ripple across academic and cultural communities in Pakistan.

Many of you have been instrumental in supporting and mentoring the Pakistani faculty and students who visited the United States as part of the exchange program. I would like to offer my heartfelt thanks and share with you the impact of the experience for all.

DR. SAYFE KIAEI Project Director, USPCAS-E

SCHOLAR PROFILE: SHAZMINA JAMIL WORKING TO ENSURE A BRIGHT FUTURE FOR PAKISTAN

Growing up, Shazmina Jamil had to change minds. She explains that in Pakistan, people don't see girls as engineers, engineering is seen as a male-only realm. But she definitely had an engineering mindset from an early age, being curious about how things worked and taking things apart to see the inner workings for herself.

"I always had a passion for learning new things and a thirst for understanding the latest technologies," Shazmina explains.



She worked to change minds bit by bit in her community and family, changing the concept of who can be an engineer.

"The concept that only boys could be engineers was a concept that I had to overcome. I did that and I am the first girl in my family to become an engineer."

Shazmina is now a graduate student in electrical energy/power systems at the U.S.-Pakistan Center for Advanced Studies in Energy (USPCAS-E) at the University of Engineering and Technology (UET) Peshawar. She's from Kohat, in the Khyber Pakhtunkhwa province of Pakistan. After earning her undergraduate degree in electrical engineering at UET Peshawar, continuing on as a graduate student with USPCAS-E was a natural next step.

"When I was getting my undergraduate engineering degree, I knew that I wanted to do research in power systems. After graduating, I decided to pursue a master's degree," Shazmina says.

ENVISIONING A 24/7 POWERED FUTURE FOR PAKISTAN

Shazmina wants to see full-time availability of power in her home country. She wants everyone to have the freedom to pursue any activity without worrying about power availability.

"I want my people to have 24-hour access to power. I want everyone to be able to study when they want, to cook when they want, and to do anything that they want without worrying about outages," Shazmina explains.

Shazmina's research focuses on phasor measurement unit (PMU) data for fault detection. Her work is like that of a detective, looking for system faults before they happen in order to prevent overloads and blackouts.

"I am working on PMU data for fault detection in different parts of power systems. This is important for Pakistan because currently, we can't always detect faults and prevent blackouts. In Pakistan, we now have PMUs so with this new knowledge I can better help Pakistan manage its energy network."

Shazmina knows that load shedding events impact the quality of life in Pakistan and her work focuses on identifying potential issues before systems and transformers are overloaded and power outages occur. Power outages can affect Pakistanis for 12 to 16 hours a day greatly interfering with economic activities and everyday life.

THE POWER OF EXCHANGE

Shazmina says that the best part of her USPCAS-E experience has been the exchange program.



"The exchange program was an amazing experience. I am excited to be learning these things in the U.S.," she says. It's really awesome working in the lab. I have learned a lot of things but I am most excited about learning the way that research is done at ASU and will take that knowledge back with me."

In addition to learning about the research process in her lab at ASU, Shazmina has also learned a lot about American culture in her first visit to the United States.

"There are many misunderstandings about America in my country, so it's nothing like what I expected. The American people are very welcoming and adaptive, accepting people from all different countries and cultures."

Shazmina echoes the sentiments of other exchange scholars in her admiration of the good time management, hard work, rule following (like traffic laws), and the management of public spaces and venues like Disneyland and national parks that she has observed in the United States. She noticed that even very crowded areas are well managed in the U.S.

"We need to implement these things at home in Pakistan."

Shazmina observed that it's easy to follow her culture when she's at home in Pakistan but being immersed in another country gave her a new appreciation for her own culture as well as an appreciation for other cultures.

"I really learned to follow my culture and value my own norms while living far away from home and at the same time, appreciating and accepting others."

After graduation, Shazmina plans to continue her research and hopes to pursue a Ph.D. in the United States.



PROMOTING ACTIVE LEARNING IN THE CLASSROOM

How do you transform the classroom experience and make the learning process engaging meaningful and relevant? How do you ensure that students really learn the material? These questions are at the heart of USPCAS-E efforts to reimagine the energy education curriculum at its partner universities in Pakistan.

The USAID-funded USPCAS-E program organized a professional development workshop in Pakistan for UET Peshawar and NUST faculty on active learning methodologies. Active learning is a process that involves students as active participants and partners in the learning process. About three-fourths of the 30 center faculty participated in the training to learn how they can improve classroom learning. Ten staff including research associates and lab managers also participated. The overall goal is to create a learning environment that promotes student learning and helps students excel as designers, problem-solvers, critical thinkers, team members and leaders.

The three-day workshop held January 15-17, 2019, was facilitated by Dr. Peter Rillero, an associate professor of science education at Arizona State University. This workshop was part of a comprehensive program designed specifically to improve teaching practices at the USPCAS-E centers and will lead to an Advanced Instructional Methods (AIM) certification.

The training is designed to be repeatable for the benefit of all current and future faculty and staff.

Workshop topics included higher-level thinking, questioning techniques, assessing and engaging through classroom response systems, and the scholarship of teaching and learning. The workshop provided participants with hands-on experience using two real-time student response systems, Socrative and Plickers. These apps allow instructors to collect data from their students through their own devices, including smartphones and laptops, or with verbal responses. Student response systems provide learners with real-time feedback on their understanding of a topic and they provide instructors with a gauge of their students' understanding of the material.

Dr. Muhammad Noman and Dr. Affaq Qamar from UET Peshawar and Dr. Arsalan Khawaja from NUST also facilitated sessions on active learning and shared their experiences from the International Society for Exploring Teaching and Learning conference held in Arizona in October 2018. All three faculty recently returned from an exchange program at Arizona State University. The exchange program provides faculty and graduate students opportunities to expand their knowledge base and professional networks in an immersive program that exposes them to new ideas, methods and approaches to energy engineering.

The USAID-funded USPCAS-E program is helping faculty to improve the quality of course delivery and assess outcomes in the teaching and learning environment in order to promote continuous improvement.



SCHOLAR EXCURSION OPENS MINDS AND HEARTS

"This trip was one of the most memorable ones of my life!" recalls Asfandiyar Khalid. "After visiting the Hoover Dam and Griffith Observatory, I realized how these places were converted into great tourist spots which in turn created employment opportunities and prosperity in the region," he says.

As part of the USPCAS-E exchange program, scholars from Pakistan were taken on a week-long cultural excursion to the Grand Canyon, Hoover Dam Power Plant, Griffith Observatory, Ivanpah Solar Power Plant and several other destinations.

"I observed Native American culture, their way of living, their houses and their dance which was modeled at the Grand Canyon," said Qandeel Rehman.

The Hoover Dam visitor center and power plant visit exposed the exchange scholars to the massive concrete structure built in the 1930s on the border of Arizona and Nevada. They learned about energy policy and its role in the construction of Hoover Dam for irrigation and power generation.

"All values of American culture are worthy of respect, and above all the discipline and time management of Americans is very appreciable," says scholar Shazmina Jamil. "Tourism is not only fulfilling our wish to visit a place, but there also are multiple dimensions to it, for example, meeting new people, learning about their culture, making a comparison of the two countries, and learning to make our nation better in a more diverse way."

Haider Sami remarked that this excursion was an amazing and life-changing experience for him.

"It has been an action-packed learning adventure that reflected not only American culture but gave us a chance to interact and share our cultural values with fellow Americans. Going to Universal Studios and Disneyland was the best part of the whole tour, a truly magical experience," Sami says. "I always used to shy away from scary rides and had a tough time untangling the fun and fear of experiencing something out of my comfort zone, but being able to make that leap now feels like nothing less than a huge accomplishment."

Overall, this fun-filled educational trip helped the scholars learn about leveraging local industries to promote social values and boost the local economy, and looking at how renewable energy can be implemented in multiple sectors, including the tourism sector, at venues such as Disneyland and Universal Studios.

INTERNATIONAL CONFERENCE



FIRST INTERNATIONAL CONFERENCE PUTS USPCAS-E CENTERS ON THE ENERGY MAP

"You're not going to solve Pakistan's energy crisis from Britain or the U.S. or any other place in the world," said Arizona State University professor Dr. Clark Miller in a Pakistani television interview in 2016. "You're going to have to own it and solve it here."

Three years later, and on the heels of the first-ever International Conference on Sustainable Energy in Pakistan (ICSEP), it's evident that Pakistani faculty, students and government representatives are doing just that.

The conference, held March 12 and 13 at the National University of Sciences and Technology (NUST) in Islamabad, was organized and hosted by the U.S.-Pakistan Centers for Advanced Studies in Energy (USPCAS-E) project's three partners: Arizona State University (ASU), the University of Engineering and Technology (UET) Peshawar, and NUST. The conference was a seminal event featuring 11 international speakers and more than 550 participants, 120 of whom were Pakistani women pursuing technical careers in the energy sector.

"I see this conference as a valuable addition to Pakistan's now flourishing energy sector, and specialized research centers like USPCAS-E surely will play an instrumental part in providing sustainable and renewable energy solutions for Pakistan's energy challenges," said Mr. Omar Ayub Khan, Federal Minister for Power Division, in his address as the conference's chief guest.

Sustainable research centers, which produce sustainable energy solutions for Pakistan, are critical. And that's why this international conference was so monumental. It's a critical step in ensuring the long-term sustainability of the two USPCAS-E research centers in Pakistan, which were created as part of a collaborative five-year project with an \$18 million investment from the United States Agency for International Development (USAID). The project is now in its fifth and final year of USAID funding.

Mr. Jerry Bisson, USAID Mission Director, said: "One of the most important investments we can make moving forward is in the institutions that foster innovation and the great minds that convene within them."

USPCAS-E was established with a driving mission to cultivate and grow indigenous talent in Pakistan specially trained to tackle the country's mounting energy challenges. The project's main goals are to focus on applied research relevant to Pakistan's energy needs and help produce skilled graduates in the energy field.

BUILDING ON ACCOMPLISHMENTS

Since the project's inception in 2014, USPCAS-E has, among other accomplishments:

- Built two new buildings, housing 16 labs and two libraries, at NUST and UET Peshawar.
- Developed 14 new degree programs at NUST and UET Peshawar.
- Initiated 48 joint and applied research projects.
- Established nine public-private partnerships.
- Graduated 184 Pakistani students with energy-related master's degrees.

USPCAS-E leadership and faculty decided to build on these accomplishments by hosting ICSEP, which fit perfectly into the overarching goals of the project in many ways.

"ICSEP provided a forum to highlight and disseminate the centers' achievements in applied research to the industry, academia, government and civil society," said ASU USPCAS-E Deputy Director Ahmad Saeed, who is based at NUST.

"Our stakeholders were able to get a better understanding of the high caliber of the faculty and graduates of the two centers. The conference also provided an opportunity to the faculty and students to network and learn from the experiences of the prominent international and national energy experts who attended."

Conference speakers were selected for their cutting-edge research and application in key areas including:

- **Energy policy and management.** Highlights in this area included a presentation by USPCAS-E Director and ASU professor Dr. Sayfe Kiaei, on future trends in energy. Another notable speaker was Dr. Adil Najam from Boston University, who presented the idea of distributed generation in a whole new manner and highlighted how a challenge can be converted to an opportunity.
- **Renewable energy.** Dr. Jawwad Darr of University College London-UK gave a keynote on new approaches and capabilities for energy storage materials, as well as an update on the UK Faraday challenge for energy storage. Another keynote was given by Dr. Kamaruzzaman Sopian of Universiti Kebangsaan in Malaysia, who focused on advances in photovoltaic thermal solar collectors.
- **Thermal energy engineering.** Technologies, barriers and research in the area of advanced biofuels via biomass gasification were discussed by keynote speaker Dr. Edd A. Blekkan, a professor at Norwegian University of Science and Technology (NTNU) in Norway.

STUDENTS SHINE IN RESEARCH POSTER SESSION

In addition to the plenary talks, technical sessions and panel discussions that happened throughout the two-day conference, faculty and students at USPCAS-E were able to showcase and discuss their work with visiting experts and local stakeholders. A total of 42 Pakistani students — 21 from UET Peshawar and 21 from NUST — presented research posters.

"In the poster session, the students had an opportunity for local industry and fellow researchers to critically assess the work they presented on their posters," said Dr. Tanvir Ahmad, a UET Peshawar professor and conference organizer. "Some of my students are already invited for meetings by industry professionals to get more information about their ongoing projects."

THE BEGINNINGS OF CROSS-SECTOR COLLABORATION

From an economic perspective for Pakistan as a whole, the international conference marks the beginning of a new chapter between universities, industry and international partners to work together to address energy challenges.

"It demonstrated the importance of the USPCAS-E centers and the fruition of students graduating with advanced degrees to help lead the effort," said Dr. Sayfe Kiaei. "This project has brought a significant number of local energy experts to Pakistan's economy."

There are global ramifications, as well. Conference organizer Ahmad Saeed said: "Overall, ICSEP helped in putting USPCAS-E on the energy map of not only Pakistan but the world. It emerged as a credible energy research institute undertaking cutting-edge applied research in energy."

That's a fantastic outcome, especially given the challenges that USPCAS-E faculty had to overcome in planning the conference. Chief among them were safety concerns that invitees had with traveling to Pakistan.

"At the moment, due to security challenges, Pakistan is not a favorite travel destination," said Saeed. "We had some speakers cancel due to concerns, but past experience with international conferences shows that the scientific community embraces greater courage to stand by their comrades in difficult times, and ICSEP was no different. The majority of our invitees chose to visit Pakistan, and I think the conference showed a softer side of the country."

"It helped bring people closer and address biases and any misunderstandings which may have existed for any reason. I would call the conference a resounding success."

BY JEN KENNEDY



Jerry Bisson



Omar Ayub Khan



USPCAS-E master's student Leena Aftab, right, received first prize in the student poster competition.



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ON OUR WEBSITE, USPCASE.ASU.EDU

LEADERSHIP TRAINING



BUILDING THE NEXT GENERATION OF LEADERS: Ensuring a bright future for the USPCAS-E centers

One of the focus areas of the USPCAS-E project is to ensure the sustainability of the centers after the life of the five-year USAID-funded project. The centers are expected to become think tanks for Pakistan's energy sector providing training, guidance and innovation for years to come. The success of this effort depends in large part on the people—faculty, staff, students and stakeholders—who will lead the ongoing efforts to find sustainable energy solutions for Pakistan.

To support these efforts, USPCAS-E hosted a multi-day leadership training in Islamabad for academic leaders at NUST and UET Peshawar. This training was led by Professor Dan Shunk. A renowned leadership trainer with over 30 years of experience in leadership training, Shunk is the Avnet Chair and a professor of industrial engineering in the Ira A. Fulton Schools of Engineering at Arizona State University.

Professor Shunk's research and teaching expertise includes strategic innovation, new product development and strategic academic planning; strategic, top-down operational excellence; enterprise modeling and integration focusing on material flow/information flow/knowledge flow supply network integration.

This training was designed to help the centers at NUST and UET Peshawar develop the leadership skills, bandwidth and capacity to ensure the sustainability of the Centers for Advanced Studies in Energy beyond the life of the USAID-funded project.

TRAINING GOALS

- Provide an overview of modern leadership principles that will facilitate sustainable organizations and ventures.
- Assess the leadership and strategic capacity at the centers.
- Develop a 360-degree leadership assessment.
- Review and discuss the intrapersonal and interpersonal traits of good leadership.
- Demonstrate how leaders can make change happen.
- Establish an understanding of how organizations create a culture of innovation.
- Discuss strategic planning and implementation principles for sustaining start-up ventures.
- Develop center-level goals and implementation plans to achieve these goals.
- Discuss ways to obtain new funding streams once the USAID funding ends.
- Articulate how center contributions to the Pakistani energy sector create value.
- Create a sustainability strategic plan for each center.

The training provided attendees with a focused, hands-on opportunity to work together with their colleagues to draft strategic plans with the benefit of expert guidance from Dr. Shunk.

Bringing knowledge home: USPCAS-E grads aim to spread lessons learned

Some visitors leave the U.S. with a miniature Statue of Liberty or Grand Canyon photos. USPCAS-E scholars leave the country with transformational knowledge they'll put to good use in their native Pakistan.

Two such scholars are Afshan Qamar and Farooq Umar. They've both earned master's degrees from NUST and established impressive research credentials. Now they're headed to doctorate-level study to further the expertise they will eventually apply to solving Pakistan's energy crisis.

SEEING THE BIGGER PICTURE

Both Qamar and Umar had degrees in electrical engineering when they were admitted to the USPCAS-E program, and both are firmly focused on developing renewable energy resources for their energy-strapped nation. Each clearly sees that the value of renewable energy extends beyond the electricity generated.

"I did my first job in electrical power stations," says Umar. As an electrical maintenance engineer at a utility, he was dismayed by what he saw streaming from conventional, coal-fired power plants: pollution. Nearby, however, he saw solar plants.

"I got really inspired by seeing that clean power. That is why I made my decision and quit my job."

Umar discovered the USPCAS-E program through a colleague from his undergraduate studies and applied.

"My friend was doing his master's," he says, "And his knowledge was very up-to-date. He had the latest technology to use with this program."

Qamar had been focused on renewables from her undergraduate days. While she values clean energy, she also recognizes the economic benefit that renewables deliver.



"Right now, the sources we use to create electricity in Pakistan are mostly oil and coal and, of course, they are very expensive," she says. "We're spending a huge amount from our economy on resources we're importing."

Renewables, she knows, can help stop that flow of money out of the country and also create trickle-down benefit.

"When you invest in renewables, you're not only creating electricity; you're creating jobs. A lot of people are involved: designers, manufacturers and the people who are installing these systems," she says.

OPENING A DOOR TO OPPORTUNITY

Participating in the USPCAS-E program put both Qamar and Umar at opportunity's door. As hoped, Umar found himself working in a well-equipped lab with top-tier technology, and he credits his experiences at Arizona State University with giving him the foundation to do one of the projects he's working on now: developing a smart solar inverter specifically designed to respond to the frequent load-shedding events Pakistanis endure. Load-shedding is when the electrical power supply is intentionally shut down to avoid excessive load. This disrupts power availability and everyday life. An inverter helps to keep certain devices running during load-shedding.

"It is very different from the inverters available in the local market," he says. "The number one benefit is that it has more efficiency."

That's because some inverters currently made in Pakistan can have efficiency as low as 20 percent, while 80 percent is the upper rating. Umar is designing an inverter he expects to deliver 90 percent efficiency, and it also can be run on-grid or off. That means the inverter can decouple from the grid, and load shedding can happen without necessitating curtailment of the solar generator or storage unit the inverter is attached to.

Along with gaining technical skills, Umar says his experience in the U.S. fostered personal growth, partly through the interaction with other professional researchers and partly through exposure to people of different backgrounds.

"ASU is a very diverse university. I went to an event, International Student Night, and there were people from 42 different countries. I have friends from India, the USA, China and Japan."

Qamar echoes these sentiments.

"The U.S. is the place where you have people from every country and every religion," she says. "That was a very good experience: seeing people with different cultures, behaviors, manners, religions and foods."

Like Umar, Qamar also values the experience she gained working in a world-class laboratory.

"The big thing for me is the experience I got at the Solar Reliability Lab at ASU," she says.

The center focuses on predicting the lifetime of solar photovoltaic (PV) modules for various climatic conditions by applying statistical tools. Qamar worked under the guidance of Dr. Govindasamy Tamizhmani (Dr. Mani), a PV research veteran at ASU with some 32 years of experience and more than 150 published papers.

One of Qamar's research projects during her USPCAS-E studies involved creating a mathematical model that tracks the health of a PV system.

"You can see how your system behaved, how much energy you produced and compare that to how much energy you should produce," Qamar says. "The analysis gives you insights to help you install systems in different areas in Pakistan so that they can deliver maximum performance."

Qamar's other USPCAS-E project involved working on a micro-hydro system capable of generating electricity using the flow of small streams.

"The purpose was to electrify remote communities, especially in rural areas," she says.

Through her USPCAS-E research projects, Qamar was able to contribute to two professional papers, a good start to the publishing life that is central to an academic career.

WORKING TODAY AND WORKING TOWARD TOMORROW

Qamar is headed to graduate school again, hoping to be admitted to a university in Canada so she can explore another country. For now, she's teaching classes at two private universities in Pakistan. Once she completes her doctorate, she hopes to continue teaching in her native country and also consult within the energy industry there.

Umar is teaching as well, plus he's conducting research, including the solar inverter project noted before as well as the development of an AC motor test bed that is based on international standards to evaluate the efficiency of large industrial motors. The goal is to identify non-compliant and inefficient motors in the national grid.

Like Qamar, Umar is also headed back to North America, and he's awaiting word on admission to a doctorate program. He'll be attending a U.S. school on a Fulbright Scholarship, one of the most competitive and prestigious fellowship programs in the world. According to Umar, his USPCAS-E experience helped him earn that scholastic honor.

After he earns his doctorate, Umar dreams of enriching his hometown university, which he says now suffers from a lack of doctorate-level teaching fellows.

"I want to bring contracts, funding and good people," he says.

He also wants to encourage entrepreneurship locally in the energy sector.

The similar path these two scholars have chosen to take reflects the life-changing knowledge they acquired through their USPCAS-E studies.

"It gives me my vision," Qamar says. "Now I am very clear on what I should do and what I will do. That is because of USPCAS-E."

BY BETSY LOEFF

ABOUT USPCAS-E

The U.S.-Pakistan Centers for Advanced Studies in Energy (USPCAS-E) is a five-year program implemented by partners National University of Sciences and Technology (NUST), University of Engineering and Technology (UET) Peshawar and Arizona State University (ASU).

The project focuses on applied research relevant to Pakistan's energy needs. The program has multiple goals including curriculum development, applied research, the establishment of new laboratories, and international visitor programs.

Partnering Universities:



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