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ENERGIZING RESEARCH

USPCASE research collaborations take on Pakistan's energy sustainability challenges

A lack of sustainable energy sources in far-flung underdeveloped regions is among the most daunting roadblocks to quality of life still plaguing much of the world.

The challenge is not only technological — requiring advances in engineering and science — but also economic, cultural, educational and governmental. Those causal factors figure into the pursuits of the U.S.-Pakistan Centers for Advanced Studies in Energy, called USPCASE.

Funded by the United States Agency for International Development, known as USAID, the program partners Arizona State University with the National University of Sciences and Technology, known as NUST and the University of Engineering and Technology Peshawar, known as UET-P, two of Pakistan's leading institutions of higher education. Oregon State University works with ASU to host exchange scholars in the U.S., facilitate workshops in Pakistan and partner on joint research projects.

Through the collaborative efforts of researchers at each of the universities, USPCASE is developing multifaceted energy solutions with the potential for global impacts beyond alleviating Pakistan's severe energy deficiencies.

There are five components to the USPCASE project — curriculum, research, student and faculty exchange and scholarships, governance and sustainability. (See uspcase.asu.edu/focus-areas for details).

Joint research projects pair NUST and UET-P faculty with ASU and OSU faculty. Pakistani faculty benefit from working with faculty from larger and more mature research environments and gain skills and experience needed

to be competitive in future funding opportunities. As part of the five-year project, USPCASE is to undertake 11 joint research projects, six with NUST and five with UET-P.

In addition to joint research projects, USPCASE is facilitating 30 applied research projects in Pakistan, 15 each at NUST and UET Peshawar. NUST is also awarding 10 applied research projects to students with each awardee receiving \$5,000 for their project.

The applied research projects are funded for 12 months and are focused on finding immediate energy solutions for communities and promoting scientific research in areas relevant to national needs.

Energy deficiencies hampering Pakistan's progress

USPCASE focuses on creating models and methodologies that could lead to establishing robust energy development initiatives. By connecting researchers internationally, USPCASE is encouraging the social and political progress necessary for successful long-range planning and support in the energy sector.

"One of our big ambitions is to provide paths to solutions that

can be significant contributions to many countries and to many energy industries," says Ahmed Sohail Khan, a mechanical engineer and a USPCASE technical advisor and research scientist.

Pakistan offers what is in effect a universal testbed for possible remedies to many energy development challenges, Khan explains.

The country has about 200 million people living in densely populated areas with an insecure supply of electricity. Many areas endure frequent rolling power outages that can last for 10 hours or more. More than one-quarter of Pakistan's population have no access to electricity at all, living primarily in rural areas far from the country's electric grid.

USPCASE faculty and students are researching ways to provide access to power in rural areas, while also researching renewable sources and energy efficiency.

"There are no policies in Pakistan to require that houses be energy efficient," Khan says, "so many people live in housing that is poorly designed and built, and their homes use enormous amounts of energy, so a lot of it is wasted."

The energy inefficiencies also raise production costs for many industries,



"INDUSTRY IS NOW COMING TO US. THEY ARE INTERESTED IN OUR LABORATORIES AND THE ENERGY POSSIBILITIES WE ARE EXPLORING."

AHMED KHAN

making them less competitive in the international marketplace and dragging down the national economy “through billions of dollars’ worth of lost productivity,” he adds.

Khan says the situation is made more frustrating by mismanagement and a lack of political leadership to take on the hard work to develop and put in place a comprehensive energy policy.

A diverse array of energy projects

Through both the research and education components of USPCASE, groundwork is being laid for developing comprehensive energy policy. Joint research projects span a range of focal points, including power systems, electric power grids, solar energy and related photovoltaic technologies, thermal energy, micro hydro hybrid systems and energy materials. There are also studies on energy policy, economic management and energy security.

Collaborative endeavors benefit faculty and students

ASU Professor Arunachala Mada Kannan worked with NUST faculty Majid Ali and Muhammad Aamir and OSU faculty member Brian Fronk on a solar power space-heating system involving a solar thermal collector, thermal energy storage unit and a radiator heat exchanger. Kannan says such collaborative efforts foster interaction that produces benefits through the varied array of expertise that research team members bring to the work.

“We always achieve a synergy that results in something better than what we could accomplish alone,” he says.

Equally as valuable, joint research projects lead to other kinds of collaborations, particularly co-authoring papers for publication in research journals and generating ideas for innovative approaches to future research, Kannan adds.

The collaborations are also providing ASU, NUST and UET-P graduate students valuable experience in advanced multidisciplinary research.



It is an especially sought-after opportunity among students at the Pakistani universities who typically are given little hands-on training in research labs in their country.

In most USPCASE research collaborations, students “are developing classical mathematical models and implementing the theory into practice,” says Edward William, a technical advisor and research scientist for the program.

Some of the students assisting on USPCASE projects also receive funding to cultivate new ideas and are being provided sources of data and technologies to support their lab work, William says.

Promoting knowledge sharing and cultural exchange

In addition to joint research project visits, USPCASE has a visiting scholar program at ASU each semester for both Pakistani graduate students and faculty members. They get research training in one of eight labs on ASU's Tempe and Polytechnic campuses that focus on energy policy, energy materials, power systems, power electronics, fuel cells and batteries, photovoltaics reliability and thermal energy.

So far, more than 135 NUST and UET-P graduate students and faculty have completed semester-long exchange programs enabling them to study at ASU and participate in research. ASU and OSU faculty members also visit the Pakistan universities to work on joint research projects.

More than 200 students and faculty are expected to participate in the research and cultural exchanges over the life of USPCASE project. Even more faculty and students benefit from a series of research workshops held in Pakistan that are facilitated by ASU faculty and international experts.

The exchange students also benefit from the USPCASE program's professional development instruction, which includes studies in policy and entrepreneurship to prepare students to be Pakistan's future leaders in energy development efforts.

Working to sustain what USPCASE has started

One of the most important impacts of partnering with a research university of ASU's stature and capabilities are the connections this relationship is helping to build between government, industry and university researchers in Pakistan, says Ahmed Khan.

“Industry is now coming to us. They are interested in our laboratories and the energy possibilities we are exploring,” he says.

“We are taking some important steps forward on technologies and power systems,” says Khan, adding that many of Pakistan's government and industry leaders are recognizing the goals of USPCASE endeavors as critical to the country's social and economic stability.

“It gives us hope of being able to sustain our research projects and of getting the support to stand on our own in the future,” Khan says.

By Joe Kullman

See a complete list of projects online at uspcase.asu.edu/energizing-research.

STAKEHOLDERS MEETING AND RESEARCH EXPO

Stakeholder Engagement: Keeping an Eye on Long-Term Success

Many research projects have a well-defined beginning and end. But what happens when the end is really just the beginning? The U.S.-Pakistan Centers for Advanced Studies in Energy are working to make sure that the end of their USAID-supported project marks the beginning of a sea change: a broad transformation of energy engineering research and education in Pakistan. Key to project success is sustainability: building new centers at two Pakistani universities that will flourish after the life of the initial project. These centers are envisioned as emerging think tanks that are responsive to energy sector needs — creating innovative solutions to tough energy problems in Pakistan.

USAID is the lead U.S. Government agency working to end extreme global poverty and enable resilient, democratic societies to realize their potential. To create and strengthen a culture of applied research, USAID launched the U.S.-Pakistan Centers for Advanced Studies in Energy focused on finding ways to increase energy production and availability, with an emphasis on renewable energy and energy production in remote areas, as well as energy storage and transmission, and energy policy.

With significant expertise in power systems, photovoltaics and renewable energy, policy and related energy engineering, Arizona State University (ASU) was selected to lead the project working with National University of Science and Technology (NUST) and University of Engineering and Technology in Peshawar (UET) along with partner Oregon State University (OSU). Together, they are building a network of stakeholders invested in the ongoing success of the centers.



To engage and inform its stakeholders, USPCASE hosts biannual meetings to share project updates and outcomes and to invite input and feedback on curriculum, research projects and more. USPCASE held its fourth annual Stakeholders Meeting and Research Expo on April 25, 2018, at the Islamabad Serena Hotel in Pakistan.

Fostering Partnerships and Ensuring Sustainability

Stakeholder engagement is key to the sustainability of the Centers for Advanced Studies in Energy. The centers are developing a critical mass of expertise, creating an educated workforce through the preparation of graduate students, developing technical and policy solutions, and providing technical bandwidth to public and private energy organizations in Pakistan. In order to promote modernization and relevance of the curriculum, strengthen policy decisions and drive innovation, USPCASE is engaging with a wide range of energy sector stakeholders in Pakistan.

Ongoing engagement with stakeholders through one-to-one meetings and industry visits affirm that the centers are developing relevant curricula and research agendas that respond to both public and private sector needs for the long term. Stakeholder engagement with USPCASE increases year over year with participation nearly doubling each year.

“Stakeholder input and feedback are critical to the success of the Centers for Advanced Studies in Energy at NUST and UET,” explains Sayfe Kiaei, Motorola Chair and professor at ASU and director of the USPCASE project. “We are building programs to be responsive to the needs of Pakistan’s energy sector. Being nimble and innovative requires multiple perspectives and stakeholder engagement is helping to create the long-term success of these centers.”

The stakeholder meetings are an opportunity to learn more about each of the program components — curriculum, research, exchange, governance and sustainability.



USPCASE RESEARCH EXPO 2018 SHOWCASED OVER 40 PROJECTS ON RENEWABLE ENERGY, THERMAL ENERGY, ELECTRICAL ENERGY AND ENERGY POLICY.

The meetings provide the latest information on degree programs, research projects and provide a forum for input and feedback.

Stakeholder Muhammad Ziauddin, Chief Executive Officer with Élan Partners (Pvt.) Ltd., points to the capacity-building aspects of USPCASE as key to future success. Young people from all walks of life are afforded an opportunity to work in a key sector and stakeholders have the opportunity to provide input to ensure that their experiences in the classroom and lab are informed by real-world challenges in the field.

THE 4TH NATIONAL STAKEHOLDERS MEETING BROUGHT TOGETHER OVER 100 REPRESENTATIVES FROM PAKISTAN'S GOVERNMENT AND PRIVATE SECTOR.

Stakeholder N. A. Zuberi, Chief Operating Officer, China Three Gorges South Asia Investment Ltd., calls USPCASE "an excellent initiative." Mr. Zuberi believes that the program is extremely important to Pakistan and appreciates that stakeholder involvement affirms that courses are aligned with the requirements of the energy sector in Pakistan.

Ammar Yasser, Corporate Engagement Specialist for USPCASE encourages stakeholders to learn more about the project. "There are a number of ways that energy sector stakeholders can work, from sponsorship of research projects to working with faculty to hiring interns and graduates."

Industry representatives may contact Mr. Ammar Yasser, Corporate Engagement Specialist for USPCASE at ammar.yasser@asu.edu

MESSAGE FROM THE DIRECTOR

In April we held our 4th National Stakeholders Meeting. These meetings provide a clear vision of what's possible for Pakistan and it's inspiring to see stakeholders from many backgrounds come together to share their ideas and expertise and to help us build a roadmap to sustainability.



In conjunction with the stakeholders meeting, we hosted our first ever Research Expo featuring research projects from ASU, UET and NUST as well as research from the Center for Advanced Studies in Water led by the University of Utah. Hundreds of people attended the Expo and it was exciting to see the hard work of our researchers and students coming to fruition. The centers are poised to cement their status as leading providers of knowledge and high-quality graduates.

In late June one of the joint research projects, Hybrid Energy Testbed for Remote Communities, began their installation at Yarabad (Jalala Canal), near Mardan, Khyber Pakhtunkhwa Province, and about 110 kilometers from Peshawar. This project offers a cost-effective solution to bring renewable energy to small off-the-grid communities. It's just one of the many USPCASE research projects that focuses on creating indigenous energy solutions for the people of Pakistan. It's easy to imagine hundreds of these systems powering small communities throughout Pakistan.

We are preparing to host the largest cohort of exchange scholars to date this fall. Every student and every faculty member in the project holds the promise of creating a new bright future for Pakistan. Thank you for supporting them on their journey.

DR. SAYFE KIAEI
PROJECT DIRECTOR, USPCASE

ENGINEERED TO LAST

Engaging industry partners to ensure long-term success

Engineers design solutions. It's what they do. So, when you're looking at an ongoing problem – the nonstop need for electric power in the modern world – you need a solution that will be as long-term as the problem itself.

That's why the U.S.-Pakistan Centers for Advanced Studies in Energy have made industry engagement a crucial part of their operations. Industry engagement is a key strategy to ensure the sustainability of the centers.

Building a support system

There are several components to the USPCASE industry engagement program, and they're all designed to make the centers more valuable to the Pakistani energy sector. One element involves leveraging the infrastructure of the centers themselves, says Ammar Yasser,

USPCASE corporate engagement specialist. The centers have laboratories, expert faculty and graduate students who conduct research in those labs, he explains.

"That infrastructure – facilities and services – we are offering to industry, charging money and creating revenue," he adds.

Revenue is a fundamental goal for the centers. When the U.S. Agency for International Development first put out a call for proposals on the project, it specified that the centers should tap industry support to increase the quality of faculty at the hosting universities – the National University of Sciences and Technology (NUST) and the University of Engineering and Technology Peshawar (UET-P). The centers need to create revenue to avoid relying entirely on public or donor financing. USAID hoped the centers would become a model to strengthen higher education that could be replicated in other sectors, universities and, perhaps, nations.

Three years after inception, staffers with the USPCASE initiative have

already established solid relationships with industry players. To date, there have been four stakeholder meetings in which executives and engineers from Pakistani energy companies and agencies provide input that guides the curriculum development at UET-P and NUST. "If the curriculum is aligned with industry need, there will be a good market for our graduates," Yasser notes.

The centers also have established formal partnerships with several organizations, including the oil and gas company KPOGCL, the Pakistani Department of Sciences and Technology, Pakistan Green Building Council, the Center for Energy Research and Development, Sky Electric, Dice and Fauji Fertilizer Company Ltd.

Along with partnerships, the centers have secured contracts. For instance, center experts were hired by the Federally Administered Tribal Areas (FATA) in Pakistan, a region in the northwestern part of the country that was created in 1947 and recently merged with neighboring province Khyber Pakhtunkhwa (KP).

There, center scholars created a 10-year energy plan to help FATA secure adequate electric generation resources and strengthen the local economy.

Plus, the centers are in the process of creating facilities from which they can offer industry certifications, equipment testing, training and more.

In addition, the centers foster relationships with organizations that will give students valuable internships to equip graduates with skills desired by industry. Approximately 70 students have secured positions that enabled them to apply lessons to real-world problems.

Going with the flow

The chronic shortage of electric capacity in northwestern Pakistan is a challenge. “KP province has tremendous potential for electricity generation through micro-hydro turbines. However, the control of these turbines is an issue,” says Muhammad Saeed, chief executive officer of Switch Mode, a company that has been working with USPCASE UET-P to develop a frequency control mechanism for micro-hydro generators.

Micro-hydro facilities typically produce between 5 and 100 kilowatts of electricity using the natural flow of water in small streams and canals. According to the U.S. Department of Energy, even streams with a depth as shallow as 13 inches could be used for such generation.

The problem, though, is frequency, as explained by Dr. Shoaib Ahmad, who is deputy director of the SAARC Energy Centre. Established under the South Asia Association for Regional Cooperation, this organization fosters energy trade, collaboration, research and knowledge sharing among all eight SAARC nations: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

“Canals run 365 days a year, 24/7, but water is flowing with a speed that is very low ... say 1.5 meters per second,” Ahmad says. This means there is no potential energy, such as that stored when water is held behind a dam. There is only kinetic energy, or the energy created by motion.

With potential energy, generator operators can control the frequency of the electricity by increasing or decreasing water flow through a turbine. Since there is no such option in these systems, operators need another solution.

In Pakistan, the grid operates at a frequency of 50 hertz, notes NUST student Afshan Qamar, who worked with Saeed of Switch Mode on electronic load controllers that could stand in for water-flow-based frequency regulation. She explains that the solution she worked on put a resistive load into the micro-hydro generator that operated in parallel with the load from users of the electricity. “As the user load goes up or down, the load controller senses the frequency on the generator and when that frequency diverts from 50 hertz, the resistive load turns on and off so that the frequency remains balanced,” she says.

Other engineers have designed frequency control devices for micro-hydro generators, but they're pricey imports, Qamar adds. “When you manufacture your own, it can be cheaper. Then more people can deploy micro-hydro,” she notes. That's a huge benefit to northern Pakistan, a region that some say could have as much as a 300-megawatt micro-hydro potential.



How much power can individual systems produce? That was the question answered by Ihtesham Ahmad, another NUST student. He worked for the SAARC Energy Centre, where he was tasked with producing a model to estimate the energy potential of any given canal. “I devised a simple software tool to estimate total annual power generation from canals utilizing any type of micro turbine,” he says. This important work was also shared with a government energy development organization.

Another student intern working for SAARC worked on finding ways to reduce the cost of small bio-gas plants used in rural areas. As SAARC's Ahmad explains, a small household bio-gas plant that uses animal manure to generate power for cooking and groundwater irrigation pumps could easily support a family of five or six people. “But in this area, the cost of those plants was around 70,000 to 80,000 rupees,” Ahmad says. That's prohibitively expensive for many people who would benefit from such systems, so a USPCASE intern worked on finding ways to cut that cost down below 30,000 rupees.

Working together

Such real-world concerns are one reason SAARC's Ahmad would like to see the USPCASE centers employ more industry participants and practitioners on the teaching staff.

Yasser, who spearheads industry engagement at USPCASE, started building alliances by conducting research to discover who's who in energy in Pakistan. To date, the program has raised more than \$1.38 million, and an endowment fund has been established at one of the centers. More than 65 percent of center graduates have gained employment in the industry, while others have gone on to start their own companies or pursue even more education.

By Betsy Loeff

WORKSHOP

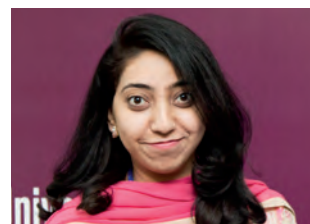


REFLECTIONS OF TRAINING PARTICIPANTS



"The training was well organized and Lou has good knowledge and expertise of his area."

— Dr. Zohaib Ur Rehman



"It was a very informative and interactive session. I learned new concepts of corporate engagement."

— Farah Batool



"I had an amazing learning experience at this training because Lou made it very interactive."

— Muniba Sana

CORPORATE ENGAGEMENT



Lou Farina led a two-day workshop on corporate engagement strategies.

Learning to engage corporate partners and secure funding from industry sources is key to the sustainability of any university research program. Faculty and staff from the U.S.-Pakistan Centers for Advanced Studies in Energy participated in a corporate engagement training workshop facilitated by Mr. Lou Farina.

Farina, a renowned expert on industry engagement, covered important topics including cultural and organizational differences between academia and industry, U.S. university corporate engagement structures, and an overview of the tools for mapping and measuring corporate relationships.

Guest speakers from Lahore University of Management Sciences and Sukkur Institute of Business Administration University introduced the participants to methods and resources being utilized in their respective universities to create and sustain mutually beneficial relationships with local corporations.

REMEMBERING GEORGE KARADY



George Karady, a professor of electrical engineering in the Ira A. Fulton Schools of Engineering and an expert in power electronics, high-voltage engineering and power systems, has passed away. Read more about his remarkable life and contributions to energy engineering: <https://bit.ly/2usVLIH>

NUST HOLDS FIRST CONVOCATION FOR USPCASE GRADUATES



USPCASE at NUST held its first convocation ceremony for graduates on April 18. Ninety-five graduates received masters degrees in energy engineering. Since the project began, more than 600 students have enrolled in newly created masters and Ph.D. programs in energy engineering at NUST and UET Peshawar.

These graduates symbolize the significant changes taking place to transform Pakistan's energy landscape and provide reliable, sustainable power for all Pakistanis.

David Hale, U.S. Ambassador to Pakistan, commended the students for their work and encouraged them to apply their expertise.

"With the skills you've gained here, you are now equipped to tackle Pakistan's most vexing energy challenges," Hale said. "Your achievement and the building we are standing in today is a testament to the 70-year partnership between the United States and Pakistan to build a brighter future for the citizens of both our countries."



LOOK ONLINE FOR MORE

FIND LINKS TO VIDEOS, PHOTOS, EVENT INFORMATION AND MORE ON OUR WEBSITE, USPCASE.ASU.EDU

THE FIFTH COHORT SUCCESSFULLY COMPLETES THE EXCHANGE PROGRAM AND RETURNS TO PAKISTAN MAY 2018



CLEAN LIVING:

Engineering student targets more hydro and hygiene for Pakistan

Qais Ali was an exchange student with the fifth cohort of USPCASE exchange scholars in spring 2018. Photo by the ASU GIS Photography Studio



Let's talk trash, real trash.

It's more than an irksome sight at the park or beach. Trash leaches dangerous chemicals into the environment, entangles and wounds wildlife, kills animals that eat it and, studies show, it's hard on mental health. One recent investigation by researchers in the U.K. found that rather than being calmed, de-stressed and restored by tranquil ocean scenery, test subjects reported feeling angry and sad when litter marred the seaside view.

Back in 2013, dismay is what hit Qais Ali as he surveyed Mukshpuri, an idyllic mountain park in northern Pakistan, where he was camping with friends. "This place is really amazing," he says. "Foreigners also come there for hiking, but when I went there I saw a lot of plastic bags and garbage all around on the top of the mountain near the camping area."

Ali is an electrical engineering master's student at the National University of Sciences and Technology (NUST) in Islamabad. He was also an exchange student at Arizona

State University during the spring 2018 semester as part of the U.S.-Pakistan Centers for Advanced Studies in Energy (USPCASE) program, a project funded by the U.S. Agency for International Development to support the education of Pakistani energy engineers. With his science and business background, Ali realized that the abundance of trash could ruin the appeal of Mukshpuri as a travel destination.

"We will lose our tourism places one by one because no one is taking care of this" refuse, he says. This awareness turned Ali's simple camping trip into a waste-management venture. "I told my friends, 'When we go hike, let's collect all these plastic bags and put them in the trash box near the roads.'"

Soon, the enterprising student had formalized his clean-up efforts into an organization he calls Green Pakistan. It coordinates a regular series of trash-collection outings and goes into schools to educate children.

As a participant in the USPCASE exchange program, Ali's state-side studies have briefly halted his cleaning activities, but he's still committed to continuing Green Pakistan.

When Ali returns to his native land after his semester at ASU, he will complete his master's degree in some three or four months. At this point, he is considering pursuing of a doctorate degree and a career in teaching, but before that, he plans to create a management team for his organization to keep it actively cleaning in the District of Swat, a mountainous tourist area and his home when not in school.



"I will expand to other areas, too," he says.

The dirty truth

According to U.S. government researchers, Pakistan generates some 30 million tons of solid waste annually, and that number is increasing by more than 2 percent each year.

"Like other developing countries, Pakistan lacks waste management infrastructure, creating serious environmental problems," notes export.gov, a website produced by the U.S. Department of Commerce. "Most municipal waste is either burned, dumped or buried on vacant lots, threatening the health and welfare of the general population."

"Proper solid waste management has never been practiced in the country," noted an October 2017 BBC article on Pakistan. "Only half of the rubbish generated is collected by the government, and there is a severe lack of adequate landfill sites."

Of the trash that isn't officially collected, some finds its way into the hands of scavengers. Some goes up in the toxic smoke of trash-burning fires. Some lands in heaps clogging streets, gutters and sewers.

"Because of plastic bags, the sewer system gets blocked and the water stops," Ali explains. "When the water stops, it stays there for months and mosquitoes breed."

The result, he notes, is that mosquito-borne illnesses like dengue fever and malaria now afflict the nation. The number of people affected by these diseases increases year after year, he adds.

"Dengue is really famous now in Pakistan, and people are dying from it because of the dirty water standing in front of houses."

Anti-junk bonds

Ali's mission to clean up Pakistan has made him an ardent evangelist of cleanliness, and he readily rallies friends and acquaintances to help him. To date, he has brought more than 100 people into clean-up activities. To advertise outings, he reaches this crew with a Facebook feed and a robust email list.

"Most of the volunteers are my friends," Ali says. "They are engineers, doctors, MBAs. Some are doing their Bachelors' degrees in physics or chemistry. All of my friends are educated people. When I talk to people around me, they get the message really quickly. They join me, and they also encourage me."



They do more than that. Many also contribute funds: \$20 here, \$50 there. Ali uses this money to pay workers to clean out sewers, as well as to buy educational materials, contest prizes and videos he uses for school visits. He hopes to make fund-raising a more regular part of the Green Pakistan program.

"It is not the work of one person. I cannot handle it alone," he says. "So, I invite more and more people, and I will make a highly qualified team of volunteers."

A nice, tidy hobby

Ali will continue his work, but he also hopes to find paid work in his field, and he dreams of bringing more micro-hydro power to his own, energy-starved area.

"There is insufficient electrical energy in Pakistan," he says, which is why he chose electrical engineering. In Swat, residents suffer as much as 12 hours per day of load shedding, hours during which the local power provider quits sending electricity into customers' premises. "I want to be able to do research and help my country come out of the energy crisis," he says.

One thing Ali doesn't plan to do is make his work with Green Pakistan his nine-to-five employment. He says he wants to keep it a passion, not a paycheck because he wants to inspire others to join his efforts.

So far, his approach is working. "Sometimes when we try to collect the trash at tourism places, the people there at the time also start helping us," he says.

Robert Cialdini, emeritus professor of psychology and marketing at ASU, has conducted numerous studies that show litter is contagious. For instance, in one experiment, Cialdini observed that subjects who found fliers tucked under the windshield wipers of their cars were less likely to toss those fliers on the ground if the area was spotless and more likely to litter if it was already full of trash.

If Pakistanis litter because their nation is already littered, perhaps Ali's efforts at cleaning up the countryside will help maintain a more pristine, healthy environment for all.

"We are the future of Pakistan. We, the young and educated people, can start cleaning by ourselves and not wait for the government to do something," Ali says. "I love to do something special for my people and for my country. That is why I'm doing this."

By Betsy Loeff

ABOUT USPCASE

The U.S.-Pakistan Centers for Advanced Studies in Energy (USPCASE) 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:



ARIZONA STATE UNIVERSITY
USPCASE.ASU.EDU

QUESTIONS AND MEDIA INQUIRIES:

Jake Kupiec, jake@asu.edu
Arsal Latif, malatif@asu.edu

IN THE NEXT ISSUE

First Think Tank Meeting and Energy Poverty Workshop Recap



**THE SIXTH COHORT
OF 38 EXCHANGE
SCHOLARS PREPARES
TO DEPART FOR U.S.**