HOW CAN WE TACKLE ENERGY POVERTY IN REFUGEE CAMPS?

PROFESSOR ELENA GAURA, ASSOCIATE DEAN OF RESEARCH AT **COVENTRY UNIVERSITY** IN THE UK, BELIEVES THAT, "ENGINEERING CAN CHANGE LIVES BECAUSE IT GIVES PEOPLE HOPE". SHE IS PRINCIPAL INVESTIGATOR OF THE HEED PROJECT, A HUMANITARIAN ENDEAVOUR FOCUSED ON INCREASING ACCESS TO AFFORDABLE AND SUSTAINABLE ENERGY FOR DISPLACED PEOPLE

Having access to the electricity and other forms of energy needed for cooking, heating and lighting is something many of us take for granted. But, according to the International Energy Agency, there are almost a billion people around the world without access to electricity. This 'energy poverty' affects regions around the world, but particularly affects people in refugee camps and those who have been displaced as a result of war and natural disasters.

To address the challenge of finding solutions to the lack of energy for displaced populations, the Humanitarian, Engineering and Energy for Displacement (HEED) project has been established. Led by Coventry University in the UK, with partners Practical Action and Scene, HEED aims to rethink the way lighting, electrification, cooking, heating and cooling, and water and sanitation systems are designed to encourage safe, scalable and sustainable solutions. To achieve these aims, the project draws on social science and engineering expertise.

Professor Elena Gaura is the Principal Investigator of HEED. The project focuses on Congolese refugees living in three refugee camps in Rwanda (Nyabiheke, Gihembe and Kigeme) and people who were forced to leave their homes as a result of the 2015 earthquake in Nepal. Elena believes that simply providing energy to populations who don't currently have it is not enough to curb energy poverty; the end-users need to be part of the process of creating and designing the solutions. It is essential that the technologies that are developed and used are effective and have high utility, i.e. meet the needs of the population and serve the purpose they were created for.

HOW DID ELENA ENGAGE WITH END-USERS AT THE OUTSET?

The team behind HEED see energy systems as socio-technical, meaning they have positive impacts that go beyond merely providing energy. "For the success and sustainability of the social eco-systems within which energy solutions are situated, it is important that there is active community involvement," explains Elena. "We therefore listened to end-user voices in all settings, such as households, businesses and community organisations, before selecting and proceeding with the energy provision interventions."

To this end, refugees were employed to survey communities about their energy needs and aspirations. Workshops were also run by the team in Nepal and Rwanda that engaged the communities in the design and implementation of the energy interventions, such as where solar street lights would be situated in the camps, for example. This vital communication with end-users provided insights into how the lack of access to energy impacts on people's daily lives. By including women in devising energy solutions, the HEED project also addressed gender inequality. For example, with a daytime focus on household chores, women had less time to take part in leisure or educational activities. The engagement with end-users highlighted the need for street lighting so that women could feel safe walking around at night; they could make the most of their free time after their household chores.

WHAT TECHNOLOGY WAS USED AND WHAT DATA DID IT GENERATE?

The team behind HEED wanted to build an evidence base on energy usage in the displaced context to develop energy solutions that provided not only for existing needs but also for future demands. To achieve this, they deployed several wireless sensor technologies which enabled them to collect data in real time and in-situ. "The data arrived directly from the household settings, sensorised energy installations, cookstoves and lanterns to our computers in our lab. This made all of the interventions and energy devices used by the many hundreds of refugees households participating in the project part of the Internet of Things," says Elena. "The sensors gave us data on everything, including the use of mobile solar lanterns provided to refugees, sockets installed on the streetlights, or lights in the buildings."

HOW HAS HEED ENABLED END-USERS TO TAKE OWNERSHIP OF THEIR ENERGY/COMMUNITIES?

Elena explains, "Technologies that are well devised help build community resilience; energy systems can transform collectives of people

TECHNOLOGICAL CHALLENGES AND HOW TO OVERCOME THEM

Throughout the course of the HEED project, Elena and the team encountered many challenges. Below are some of the challenges they faced and how they continue to work to overcome them.

COOKSTOVES

The data collected from the cookstoves on the difference between fossil fuel and alternative energy cooking temperatures can provide a better understanding of existing energy usage patterns. This information could help with future designs of cookstoves to make them more affordable and efficient, in terms of fuel consumption.

MICRO-GRIDS

The team wants to understand the impact that energy usage and demand patterns have on system performance, but also on the community. "There is still a large amount of extra energy available from our systems, so we are trying several initiatives to further promote ownership and self-governance to increase energy utilisation," says Elena. "We hope that this will have a positive impact on the lives of the refugee communities and the longevity of the installed systems."

SOLAR ENERGY SYSTEMS

Some camp residents, particularly in Nepal, were distrustful of using the solar-powered sockets attached to the streetlights to charge their phones. "Some believed that charging with batteries powered by solar energy could damage their phone," explains Elena. "We feel that there is much more work to be done in terms of education about solar energy to encourage the increased usage of the HEED sockets." The team believe that, as humanitarian engineers, they have to find ways to communicate why renewable energies are a preferable option to fossil fuel-based energy systems.

PROFESSOR ELENA GAURA

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FIELD OF RESEARCH

Engineering and Computing

RESEARCH PROJECT

Elena's research is focused on increasing access to affordable and sustainable energy. The HEED project adopts a data-centred approach to knowledge that draws upon individual narratives to understand energy demands in the context of displacement with far-reaching societal and environmental impacts.

FUNDERS

Engineering and Physical Sciences Research Council (EPSRC)

(such as those in refugee camps) into 'energy communities' that own, govern and share the sun's gift of energy."

For example, in one of the Rwandan camps, the solar panel microgrid system developed by HEED means that the community now has an electricity supply that meets their specific needs. The playground and two nursery rooms now have electricity. The outside area can be used as a community space at night, for children to play in and for adults to charge their phones. Inside, older students can use the space to complete their homework in the evening. Elsewhere, street lighting has made women feel safer at night, empowering them to spend more time out in their communities. In addition, the solar street lighting was designed to store spare energy and provide it at multiple socket points at the base of the lights. These sockets offer free energy for everyone to charge phones, laptops, and battery-operated devices, which helps the community to claim ownership of the energy interventions as it is a communal asset.

Having access to phone charging, a space for homework, lights at night – things we often take for granted – enables displaced people to live more comfortable lives and in communities that are designed by them and for them.

HEED WANTS TO EMPOWER COMMUNITIES FOR THE LONG-TERM. HOW WILL THIS BE ACHIEVED?

The structures that have been put in place to help communities were analysed from the beginning, which enabled the team to identify and address knowledge gaps that can undermine community ownership. Everyone has to buy into the project for it to succeed in the long run; Elena believes that an element of community financial gain could help sustain the shared power supply interventions and encourage community driven innovation in other areas. "We have also considered that increasing the capacities of service providers, such as community projector screenings, shared water heating for cooking or washing, or water pumps for agricultural needs could improve community resilience and capability," explains Elena.

HAS HEED HELPED THOSE WHO ESTABLISHED THE PROJECT, AS WELL AS DISPLACED COMMUNITIES, TO RETHINK ENERGY POVERTY?

In a word, yes. Elena feels that the project offered participants the opportunity to look at the role of science through a different lens. "Throughout the project, I felt a sense of empowerment supported by the capacity of the project and the way the project is driving science to 'do good'," says Elena. "But I also felt enormously humbled, realising how much we don't know about the lived experience of displaced communities in engineering, how many answers we don't really have, and how much those answers are needed now. I think this project has been the most enriching experience of my career so far."

ABOUT PERVASIVE COMPUTING

Pervasive computing (also known as ubiquitous computing) refers to how computational capabilities are embedded into everyday objects, such as clothes, cars, homes, or environments and contexts, such as parks, open areas, roads and transport infrastructure. The aim of pervasive computing is to provide computing technology that is 'smart' and inobtrusive, that supports the way in which we live our daily lives. So, your phone might connect to your fridge, which provides you with useful information – for example, you receive a message when a specific food item has gone out of date. Pervasive computing connects devices, providing information, improving our day to day experiences and increasing the usability of these devices.

WHAT ARE SOME EXAMPLES OF LARGE-SCALE PERVASIVE COMPUTING?

The ways in which we map weather can be thought of as pervasive computing: we use sensors, weather stations and satellites to acquire information about temperature, pressure and humidity. The data can also be used to visualise weather maps that make it easy for us to understand. By compiling data from hundreds of sensors, we can better understand the world, such as the fact that the climate is changing and the Earth is getting hotter.

HOW HAS ELENA USED PERVASIVE COMPUTING IN HER STUDIES?

The technologies that Elena and her team have used in the HEED project have helped them find stories in the data they have gathered. This data can be transferred into actionable information and knowledge that can change the world for the better. The area of pervasive computing is growing at a fast rate, which is leading to an increase in discoveries and innovation, and artificial intelligence is accelerating the rate even further.

IN WHAT WAYS WILL INTERNET OF THINGS (IOT) SYSTEMS IMPACT ON ENERGY USE IN THE FUTURE?

As HEED has shown, the IoT is already making positive contributions to the ways energy use is understood in the displaced context and helping to overcome problems relating to energy poverty in communities around the world. As more and more research is conducted and technology advances, pervasive computing could inform the way energy systems are designed and may one day lead to a world where everybody has access to the electricity and other forms of energy they need for heating, lighting and cooking.

HOW TO BECOME AN ENGINEER

- Much of what Elena does is rooted in sustainable engineering, which involves designing and operating systems that use energy and resources sustainably. The Engineering Council has written a document entitled Guidance on Sustainability for the Engineering Profession. It is well worth reading!
- To understand engineering more broadly, take a look at the Engineering and Physical Sciences Research Council (EPSRC) to get a better feel for some of the engineering opportunities out there.
- Humanitarian engineering involves integrating science and engineering with approaches from social sciences, law, health and medicine, management, business and economics.
- According to Target Careers, graduate engineers can expect a starting salary from £18,000 to £35,000.

PATHWAY FROM SCHOOL TO ENGINEERING AND COMPUTING

Elena highly recommends studying basic sciences, including maths and physics or chemistry, at school and college to give you a good grounding in the subjects before you go to university. The fields of engineering and computing are so broad that it is recommended that you research the specific areas you are thinking of studying to get a better idea of what to study.

To become an electrical engineer, you can do a degree in either electrical or electronic engineering. However, you can also study electromechanical engineering, applied physics or mechatronics. You can find out more here: https://nationalcareers.service.gov.uk/job-profiles/electrical-engineer.

If you are specifically interested in computing, then there is loads of information on the National Careers Service website, which lists a broad range of different careers under the computing, technology and digital banner. You can find out more here: https://nationalcareers.service.gov.uk/job-categories/computing-technology-and-digital.

It is worth remembering that engineering is no longer a single-track discipline. "Engineers need to master a range of skills, including those from computing and computer sciences, as well as social sciences," explains Elena. "This is vital if you want to engineer products that help solve economic and societal problems around the world."

HOW DID PROFESSOR ELENA GAURA BECOME AN ENGINEER?

WHAT INTERESTS DID YOU HAVE AS A CHILD?

I have always been interested in maths and building things. As a child, my interest in these subjects was useful in specific contexts, such as building doll's furniture with wood and nails!

DID YOU ALWAYS KNOW YOU WANTED TO GET INTO ELECTRICAL ENGINEERING?

My father was a field engineer and led the building of large power stations around Romania, where I was born. It always fascinated me, and no doubt propelled me into the field of engineering. However, as a girl, the only branch of engineering that was accessible was electronics, which I pursued with a passion borne from maths, physics and making things works.

WHAT HAS BEEN YOUR PROUDEST MOMENT SO FAR?

Seeing many of the 200 women scientists I trained in India for more than three years succeed against the odds in a male-dominated STEM world.

ARE THERE ANY AMBITIONS YOU STILL WANT TO ACHIEVE?

Yes! I am constantly working on developing a deeper and better understanding of people and how the technologies of the future can work for them!

ELENA'S TOP TIPS

1. If you want to become involved in the field of engineering, then a stronghold in basic sciences, such as maths, physics and chemistry, is a must. However, being widely read in humanities, social sciences, sociology and anthropology will be rewarding too. It will help you understand the purpose of technology in news ways and help you become a better innovator.

2. I think it is so important that women know they have so much more to give to the world. Without women, without their compassion, intuition, perseverance, dedication and pride, the sciences would not be the same. Remember that at all times throughout your career!

3. Listen to the world around you. You must observe it to understand it and by questioning the world, you will be in a position to make it better by engineering the systems of tomorrow!

Recharging mobile phones: *Providing sockets at the community hall means refugees can recharge their mobile phones for free (Nyabiheke, Rwanda).*

Solar street power: *Shrisha recharging her mobile phone using the sockets embedded in a solar street light (Khalte, Nepal).*