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GREEN INSIGHTS

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Clean Energy
An Eco-Friendly Alternative

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GREEN INSIGHTS
January-March 2018

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FOREWORD

Sustainability is part of everything. Eco-efficiency and innovation act as drivers to reduce environmental footprints, meet current and future environmental challenges and achieve sustainable economic growth and development. Commitment to renewable energy, efficient operations, and designing of buildings and data centres reduce waste and emissions. In today's world, there is an urgent need for exploring clean forms of energy.

In 1976 energy policy analyst Amory Lovins coined the term “soft energy path” to describe an alternative future where energy efficiency and appropriate renewable energy sources steadily replace a centralized energy system based on fossils and nuclear fuels, which is the hard path.

Clean energy relates to resources based on constantly replenishing flows of energy such as solar, wind, hydro and geothermal as well as quantities grown by nature in the form of biomass. These forms are green, clean and renewable and therefore could provide an answer to the shortage of commodities and increasing energy demands. Rising consumption of fossil fuels is still set to drive up greenhouse gas emissions and global temperatures, resulting in potentially catastrophic and irreversible climate change. Alternative energy sources can help to reduce emissions of carbon-di-oxide.

A clean energy revolution is taking place across the world, underscored by the steady expansion of the renewable energy sector. Solar and wind are mainstream sources of energy - now. Battery revolution speeds the renewable energy transition while enabling the rapid switch to electric cars. Secretary-General of the United Nations, Ban Ki-moon, has said, “Energy is the golden thread that connects economic growth, social equity, and environmental sustainability. With access to energy, people can study, go to university, get a job, start a business — and reach their full potential.” Goal 7 of the Sustainable Development Goals aims to correct this enormous imbalance by ensuring everyone has access to affordable, reliable, clean and modern energy services by the year 2030.

The present issue discusses India's ambitious aim to set up clean energy projects which have a positive impact on the country's job market. The rapid expansion of clean energy installations creates jobs and supports local economies. It also discusses the various forms of renewable energy and innovative technologies offer an environmentally sustainable and economically viable source of energy. The adoption of renewable and alternate energy resources will support sustainable growth with reduced adverse environmental impact and ensure an eco-friendly environment. To create a cleaner, safer and a healthier energy future, it is time to choose renewable first.

Road to Accelerating Clean Energy in India

India's power sector is one of the most diversified in the world. Sources of power generation range from conventional sources such as coal, lignite, natural gas, oil, hydro and nuclear power to viable non-conventional sources such as wind, solar, agricultural and domestic waste. Electricity demand in the country has increased rapidly and is expected to rise further in the years to come. In order to meet the increasing demand for electricity in the country, a massive addition to the installed generating capacity is required.

India ranks third among 40 countries in EY's Renewable Energy Country Attractiveness Index, on the back of strong focus of the government on promoting renewable energy and implementation of projects in a time bound manner.

India has moved up 73 spots to rank 26th in the World Bank's list of electricity accession in 2017, according to then Mr Piyush Goyal, Minister of State (Independent Charge) for Power, Coal, Renewable Energy and Mines, Government of India.

India made an historic contribution to energy access between 2000 and 2016, providing half a billion people with electricity for the first time. In September 2017, the Government of India launched the Saubhagya scheme to provide electricity connections to over 40 million families in rural and urban areas by December 2018 at a cost of US$ 2.5 billion.

Saubhagya Scheme

This scheme was launched with an outlay of Rs. 16,320 crores including budgetary support of Rs. 12,320 crores. Under this scheme, all willing households in rural areas and poor families in urban areas are given free electricity connections. There are around 4 crore un-electrified households in the country and they are targeted for providing electricity connections by December 2018. Rural Electrification Corporation (REC) has been designated as its nodal agency for the Saubhagya scheme.

Under the Saubhagya scheme, DISCOMs (State owned Power Distribution Companies) will also organise camps in villages/cluster of villages

to facilitate on-the-spot filling up of application forms including the release of electrical connections to households. The DISCO-Ms/Power Department will also adopt an innovative mechanism through dedicated web-portal/Mobile App for collection/consolidation of application form in electronic mode and also capturing the process of release of electrical connections. The details of consumers' viz., Name and Aadhar number/Mobile number /Bank account/ Driving License/Voter ID, etc., as available would be collected by the DISCOMs. To expedite and monitor the electrification process under Saubhagya a web portal (www.saubhagya.gov.in) is also launched.

A Lighting Revolution

The **Street Light National Programme** (SLNP) is an initiative of the Government to promote energy efficiency in the country. It is launched on 5th January 2015 to convert conventional street and domestic lights with energy efficient LED lights.The aim is to replace 3.5 crore conventional street lights with energy efficient LED lights. This would result in annual energy saving of 900 crore units and the total cost savings of municipalities every year will be Rs 5,500 crore. Under this programme, total conventional lights replaced with LED lights as on date 18th January 2018 is 4,369,918 across the country.

The newly installed lights have led to brighter streets, feeling of enhanced safety and security among the residents and motorists. Energy Efficiency Services Limited, a Public Energy Services Company under the administration of the Ministry of Power, Government of India (GoI) is the implementing agency for SLNP. The installation of LED street lights has resulted in Annual energy savings of 295 million units kWh, avoided capacity of over 73 MW and a reduction of 2.3 lakh tonnes of CO_2 annually. The project

https://www.mygov.in

has been implemented across 23 states and union territories. The lighting level on the roads have increased significantly after the replacement. The LED lighting replacement for the entire country is hoped to be finished by 2019.

Power for all

It is a joint initiative of Central Government to the State Governments with the objective to provide 24x7 power available to all households, industry, commercial businesses, public needs, any other electricity consuming entity and adequate power to agriculture farm holdings by 2019.

Grid Connected Power

Grid-interactive renewable power projects based on wind power, biomass, small hydro and solar are mainly private investment driven, with favourable tariff policy regimes established by State Electricity Regulatory Commissions (SERC), and almost all-renewable power capacity addition during the year has come through this route.

Wind Power: It aims at the generation of competitively priced grid-interactive wind power. The programme also covers research and development and survey and assessment of wind resources.

Bio-Power: Four sets of programmes are being implemented with the aim to generate

competitively priced bio power and/or heat from agricultural, agro-industrial residues and plantations and urban & industrial wastes. These are:

1. Biomass power / bagasse cogeneration
2. Non-bagasse cogeneration
3. Biomass gasifier
4. Urban & Industrial wastes

Small Hydro Power: Aims to generate competitively priced small hydro power (upto 25 MW station capacity).

Solar Power: Aims to generate competitively priced Solar Thermal and Solar Photovoltaic Power.

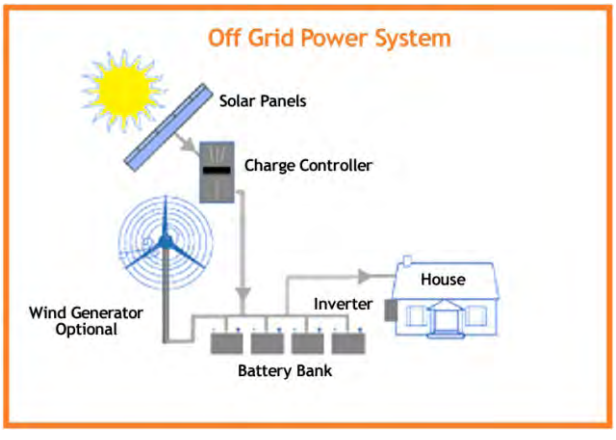
Off-Grid Power

Distributed/decentralized renewable power projects using wind energy, biomass energy, hydro power and hybrid systems are being established in the country to meet the energy requirements of isolated communities and areas which are not likely to be electrified in the near future.

Off-grid Renewable Energy / Power

Biomass based heat and power projects and industrial waste to-energy projects for meeting captive needs

- Biomass gasifiers for rural and industrial energy applications
- Water-mills/micro hydro projects – for meeting electricity requirement of remote villages
- Small Wind Energy & Hybrid Systems - for mechanical and electrical applications, mainly where grid electricity is not available.
- Solar PV Rooftop Systems for abatement of diesel for power generation in urban areas



The main objectives of the programme are supporting RD&D (Research, Design & Development) to make such systems more reliable and cost-effective, demonstration, field testing, strengthening manufacturing base.

Clean distributed energy is a powerful contributor to the national development agenda, including 'Make in India', 'Startup India' and 'Skills India.'

Source: http://www.recindia.nic.in/saubhagya
https://www.ibef.org/industry/power-sector-india.aspx
http://pib.nic.in/newsite/PrintRelease.aspx?relid=161363
http://slnp.eeslindia.org/
http://mnre.gov.in/schemes/grid-connected/
https://news.nationalgeographic.com/2017/05/india-solar-wind-renewable-power-electric-cars-leds/

Working Together to Grow Clean Energy in India

By Lea Terhune

India invested $7.4 billion in clean energy last year—and the U.S. saw a business opportunity. That's why the two countries have joined forces to support clean energy projects that will improve air quality and create jobs.

When President Barack Obama and Prime Minister Narendra Modi meet, clean energy is a topic of conversation.

And they mean business, literally. The countries' leaders encourage clean energy business investments in India to grow India's economy. Modern infrastructure will boost India's role in global manufacturing and service industries.

The U.S. India Partnership to Advance Clean Energy (PACE), launched in 2009, was re-energized in September 2014, when Prime Minister Modi and President Obama committed to expanding the initiative. It has so far brought $2.4 billion in public and private investment in clean energy projects from the United States to India.

On and off the grid

More clean energy innovations are ahead, according to U.S. Ambassador Richard Verma. "I am glad to announce that USAID is finalizing a new initiative to mobilize $41 million finance for clean energy entrepreneurs. These funds will scale and sustain their businesses beyond the early stages targeted by the PACEsetter fund," he told the India Off-Grid Energy Summit in New Delhi in August.

The PACE setter fund aims to invigorate energy-efficiency technologies in India and is a partnership between the two countries to provide grants to support off-grid renewable energy businesses, Ambassador Verma said.

https://imgv2-2-f.scribdassets.com

The Climate Group hosted the summit with the Indian Ministry of New and Renewable Energy.

The South Asia Network for Clean Energy, International Finance Corporation, USAID, Shakti Sustainable Energy Foundation, Forum for the Future, German Society for International Cooperation, Ashden India, and Clean Energy Access Network were among other summit partners.

Promoting Energy Access through Clean Energy is a related program through which the United States solicits businesses to develop ways for off-grid communities to gain access to electricity.

Getting the capital

India Clean Energy Finance Forum and the US-India Task Force on Clean Energy Finance are tools set up in February by the US Embassy and India's Ministry of New and Renewable Energy to promote discussion between the finance community and the Indian government. The forum seeks to raise $200 billion to accomplish India's ambitious clean energy goals.

The task force concentrates on government-to-government collaboration to accelerate investments in clean energy. According to a recent report, clean energy investments worldwide grew 17% in 2014. India, at $7.4 billion, was in the top 10 of investing countries. China topped the list with $83.3 billion in renewable energy investments.

Research on smart technologies

The US-India Joint Center for Building Energy Research and Development connects dozens of public and private institutions in India and the United States. This center supports innovations in solar energy, advanced biofuels and energy-efficient buildings. The initiative was recently extended another five years, and research expanded to additional areas: smart grid and grid-storage technology.

Lead collaborating institutions on solar energy at the Solar Energy Research Institute for India and the United States are the Indian Institute of Science, Bangalore, and the National Renewable Energy Laboratory. Institutions, leading advanced biofuel research are the Indian Institute of Chemical Technology, Hyderabad, and the University of Florida. CEPT University, Ahmedabad, and the Lawrence Berkeley National Laboratory head the research on energy-efficient buildings.

Text courtesy climate.america.gov

Source: SPAN November/December 2015
https://span.state.gov/science-technology/working-together-to-grow-clean-energy-in-india/20151101

Digging Deep for Energy

By Kimberly Gyatso
A freelance writer based in San Francisco.

AltaRock uses innovative technology to tap geothermal energy.

As the world strives to build a more sustainable future, geothermal energy is drawing global interest. The word "geothermal" is of Greek origin, from root words that signify "earth" and "hot."

"The Future of Geothermal Energy," a report published by the Massachusetts Institute of Technology in 2006, states, "Geothermal resources span a wide range of heat sources from the Earth, including not only the more easily developed, currently economic hydro-thermal resources, but also the Earth's deeper, stored thermal energy, which is present anywhere."

New players

The field of geothermal energy has seen the emergence of several new players, one of which is Seattle-based AltaRock Energy, Inc.

Founded in 2007 by Susan Petty and Aaron Mandell, AltaRock describes itself as a "full-

service geothermal energy technology and services company" with the ability to turn "underperforming assets into highly profitable energy projects, building and operating the geothermal power plants of the future." It has venture capital funding from Kleiner Perkins Caufield and Byers, Khosla Ventures and Vulcan Capital, the investment firm of Microsoft co-founder Paul Allen.

AltaRock is a pioneer in the field of geothermal energy because it uses new ways to effectively tap this vast energy resource. It holds a number of patents and exclusive licenses to related intellectual property for a suite of enhanced geothermal system technologies. In a 2013 article, Bloomberg described AltaRock's technology as one that "creates a geothermal source of power where none was naturally occurring" as opposed to traditional systems which only tap naturally occurring reservoirs.

The U.S. Department of Energy says that as "demand for net-zero energy campuses, military installations and offices increases, geothermal energies offer great opportunities...for near-term deployment and could provide a large fraction of the energy demand currently supplied by high-grade fossil fuels."

Innovative technology

In 2010, AltaRock and Davenport Newberry, which specializes in the development and management of geothermal opportunities, demonstrated the enhanced geothermal system technology as part of the U.S. Department of Energy's Geothermal Technologies Program at a site near Newberry Volcano in Oregon. The technology can help create geothermal reservoirs and extract heat from the earth in locations where high temperatures can be reached by conventional drilling techniques, in an effort to advance the potential of geothermal energy.

"This segment of the market will continue to grow as clean power further displaces fossil fuels... ." Mandell said in a recent press statement.

In October 2015, AltaRock participated in the Bend Fall Festival to provide information on geothermal energy research and the development taking place at Newberry Volcano, including the U.S. Department of Energy's Frontier Observatory for Research in Geothermal Energy project.

Different ventures

Since the Oregon demonstration, the company has moved on to new projects. In May 2015, Baseload Clean Energy Partners, operated by AltaRock, announced the acquisition of Blue Mountain Power LLC, which owned a 49.5 megawatt geothermal power plant in Nevada.

Baseload is now planning an improvement programme for the Blue Mountain Power project, using AltaRock's innovative multi-zone stimulation process to increase its power output. "Our goal is to bring online a new set of clean, baseload power assets and the first step is demonstrating that enhanced geothermal power provides attractive financial returns compared to other forms of clean energy," Mandell said in a press statement.

Energy potential

The company also claims that its techniques offer an environmentally sustainable and economically viable source of energy and that this technology "has the potential to provide up to 10 percent of U.S. energy needs within a generation and to do so using not only domestic natural resources, but domestic technology as well."

Source: SPAN, January/February 2016
https://span.state.gov/science-technology/geothermal-energy/20160109

Tapping the Power of the Ocean

By Kimberly Gyatso
A freelance writer based in San Francisco.

Are wave energy converters the future of clean energy?

In today's world, there is an urgent need for exploring clean forms of energy. That's why, the U.S. Department of Energy and the U.S. Navy are working with an Oregon-based company, Northwest Energy Innovations, to develop a new way of generating sustainable and clean energy—wave energy converters. The source is, as the name suggests, the ocean.

Northwest Energy Innovations' first-generation prototype, named Azura, is a 45-ton wave energy converter.

Unlike other wave energy converters, which utilize only heave (up/down) or surge (front/back) movements, Azura extracts power from both the heave and surge motions of waves to maximize energy capture. Its designers had the challenge of constructing a device that could not only convert saltwater into energy, but also withstand plenty of different motions in the rough ocean environment. And that is precisely what they did.

In June 2015, Azura's grid-connected, open-ocean pilot test was launched at the U.S. Navy's Wave Energy Test Site in Kaneohe Bay, Hawaii, at a depth of about 100 feet. The device, deployed for 12 months of testing, successfully generated grid power for Hawaii, marking the first time some American homes were officially powered, in part, by waves. Although it can only produce 20 kilowatts, the U.S. Department of Energy says that similar devices could eventually provide large amounts of clean power to coastal cities.

Azura is connected to Hawaiian Electric's grid as part of a rigorous program, supported by the U.S. Department of Energy, the U.S. Navy and the University of Hawaii, to commercialize the

http://azurawave.com

wave energy converter technology. The University of Hawaii is also responsible for independently validating Azura's performance through data collection, analysis and reporting. The data will be used by the U.S Department of Energy and the U.S. Navy in their ongoing efforts to promote wave energy technology and advance the marine renewable energy industry.

How does Azura work?

Photograph courtesy NWEIThe system produces power from the relative rotational motion between the hull, which is the upright tower structure, and the float, which sits between the hull's two columns. It has an onboard generator that converts the kinetic motion to electricity, which is then transferred to the grid via an undersea cable. What really sets Azura apart from other wave energy converters is the float can rotate a full 360 degrees and oscillate back and forth, which allows the device to extract energy across a wide variety of wave conditions and improves the overall efficiency of the system.

Northwest Energy Innovations' deployment in 2012 of a prototype at the Northwest National Marine Renewable Energy Center's test site off the coast of Oregon provided the information the company needed to refine Azura's design by

increasing power output and improving durability. That's why Azura continues to supply grid power to Hawaii, even when partially submerged under large waves. The results from Azura's trial will be used by Northwest Energy Innovations and the U.S. Department of Energy to design a new generator that will operate in bigger waves at depths of 100 to 150 feet and generate up to one megawatt of energy, which is enough to power several hundred homes.

Source: SPAN, January/February 2016
https://span.state.gov/science-technology/tapping-power-ocean/20160111

Water Power

By Jason Chiang,
A freelance writer based in Silver Lake, Los Angeles.

Stanford University scientists have made a potentially game-changing energy breakthrough, creating a cheap way to efficiently extract clean-burning hydrogen fuel directly from water.

Today, researchers across the world are working on different solutions for one of the world's most challenging issues: producing cleaner energy and its impact on the environment. The energy choices made during this pivotal time will have consequences for public health, the global climate and economies for decades to come. According to the U.S. Environmental Protection Agency, combustion of fossil fuels to generate electricity is the largest single source of carbon dioxide emissions in the United States, accounting for about 37 percent of the total U.S. carbon dioxide emissions and 31 percent of the total U.S. greenhouse gas emissions in 2013. While the combustion of fossil fuels to transport people and goods is the second largest source of carbon dioxide emissions, combustion from various industrial processes is the third largest source of emissions in the United States.

Scientists at Stanford University have been aggressively seeking cleaner and more efficient alternative energy technologies. One of their key areas of focus is hydrogen because of its natural abundance and distinctive environmental relief. In a major breakthrough, a research team led by Associate Professor Yi Cui and graduate student Haotian Wang has created a cheap way to efficiently extract clean-burning hydrogen fuel directly from water. This is a major advancement for realizing hydrogen fuel as a commercially feasible energy alternative in the near future.

The primary challenge in generating hydrogen fuel has always been reducing the cost of production technologies to make it competitive with conventional fossil fuels. Despite being deemed environmentally sustainable, the process of producing hydrogen fuel typically involves natural gas—a fossil fuel that adds to global warming. Additionally, the energy conversion process to capture hydrogen requires costly catalysts, like platinum or iridium, to drive the water-splitting reaction. Scientists have long attempted to advance a cheaper and more efficient way to extract pure hydrogen from water. The Stanford team has now achieved this, with remarkable performance efficiency.

Wang and his colleagues first discovered that nickel-iron oxide could be used as a single low-cost catalyst in the water-splitting process. “Some of the most efficient catalysts, such as platinum and iridium, are scarce and expensive, which blocks their industrialization and commercial viability,” explains Wang. “My goal was to rationally design highly-efficient, earth-abundant and cheap catalysts to replace those

noble metals, so that it could be cheaply brought to market."

By using the inexpensive nickel-iron oxide as a single catalyst in the chemical reaction, Wang and his colleagues found their innovative water splitter could produce both hydrogen and oxygen gas continuously for more than 200 hours—a record that easily outperformed the more expensive metal catalysts. "People want to utilize clean energy to do everything, currently done with fossil fuels, such as heat their houses and drive their cars," says Wang. "Some of our future goals are to produce clean hydrogen as energy carriers for home use or cheaper hydrogen fuel cell vehicles."

Cui and Wang's exploration of new electro-catalysts is just one of the many novel energy technologies made possible by Stanford's Global Climate and Energy Project (GCEP). It is a long-term effort aimed at developing innovative energy research programs for technologies that are efficient, environmentally conscious and cost-effective when deployed on a larger commercial scale.

Richard Sassoon, managing director of GCEP, is optimistic about the impact of Cui and Wang's single-catalyst water splitter, along with the other projects chosen in their current funding cycle. "If we can effectively and economically introduce hydrogen into our energy system, it could also have a huge effect on global carbon emissions. Our biggest challenges for the future will be finding ways to assist in translating these breakthroughs into widely-deployed commercial products and services."

Q&A with Richard Sassoon

Can you briefly discuss the six new research projects that were selected in this funding cycle? What set them apart and made GCEP so excited about their prospects?

These new research projects represent four awards made to Stanford faculty in a variety of energy areas and two awards that were made to outside universities in the area of carbon-negative energy supply technologies. The four Stanford projects are all excellent science, offering the potential to lead to breakthroughs in reducing worldwide carbon emissions, if successfully deployed. The two projects external to Stanford go even further by trying to design systems that would not only produce energy, but also actually reduce carbon emissions at the same time. These types of approaches could be very important, especially later this century, if we have not been able to reduce greenhouse gas emissions enough in the meantime.

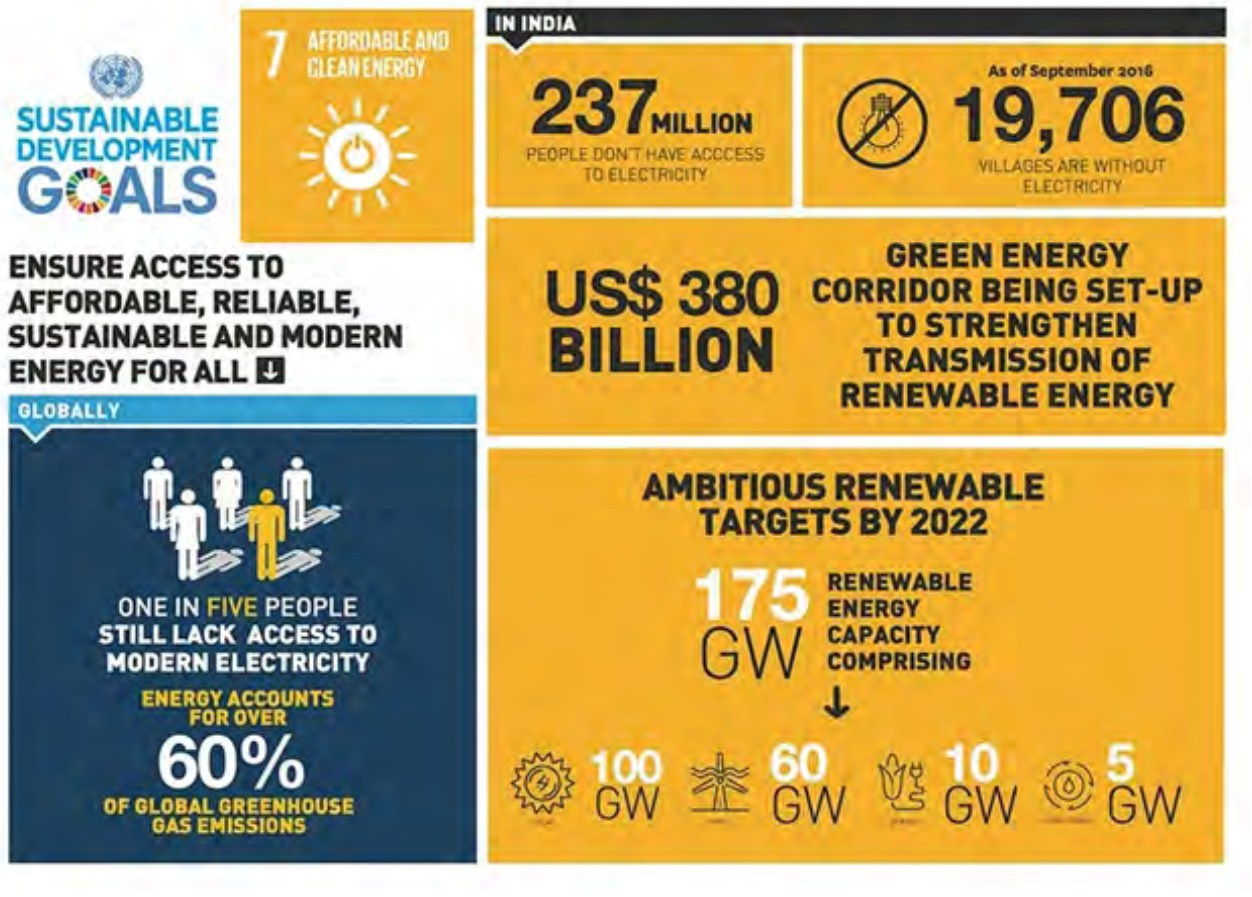
Which potential real-world applications of GCEP's research are especially intriguing to you?

Among the close to 100 research efforts that GCEP has supported, I believe many have the potential to lead to intriguing real-world applications. From the six recently-selected projects, building a device that combines a combustion engine with a more efficient fuel cell could have a huge impact on reducing carbon emissions if it is widely used in transportation vehicles.

What are some of the other areas related to sustainable energy that your team is interested in further exploring?

As we look to the future, we would like to build on the capabilities that have already been developed in areas such as photovoltaics, bioenergy conversion, batteries, fuels from CO_2, advanced combustion systems and the electric grid. We plan to work much more closely with our industry partners in identifying areas and topics that are most relevant to the energy challenge. We will be designing the next phase of GCEP to be flexible to both move forward along the already-identified promising lines of research, as well as be open to new ideas from our research investigators.

Source: SPAN, January/February 2016
https://span.state.gov/science-technology/stanford-water-power/20160101



Source: http://in.one.un.org/page/sustainable-development-goals/sdg-7/

The Environmental Information System acronymed as ENVIS was implemented by the Ministry of Environment & Forests by end of 6th Five Year Plan as a Plan Scheme for environmental information collection, collation, storage, retrieval and dissemination to policy planners, decision makers, scientists and environmentalists, researchers, academicians and other stakeholders.

The Ministry of Environment and Forests has identified Consumer Education and Research Centre (CERC), Ahmedabad, as one of the centers to collect and disseminate information on "Environment Literacy - Eco-labelling and Eco-friendly Products". The main objective of this ENVIS Centre is to disseminate information on Eco products, International, and National Eco labeling programmes.

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Project Coordinator, ENVIS Centre
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"Suraksha Sankool" Thaltej, Sarkhej-Gandhinagar Highway,
Ahmedabad 380 054, Gujarat, India.
Phone : 079-27489945/46,27450528, Fax : 079-27489947
Email : cerc-env@nic.in, cerc@cercindia.org
Website: http://cercenvis.nic.in, www.cercindia.org
https://www.facebook.com/EcoProductsEcoLabeling

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