Clean Energy

Abstract:

According to IPCC, economic development has historically been strongly correlated with increasing energy use and growth of greenhouse gas (GHG) emissions. Renewable energy (RE) can help decouple that correlation, contributing to sustainable development (SD). In addition, RE offers the opportunity to improve access to modern energy services for the poorest members of society, which is crucial for the achievement of any single of the eight Millennium Development Goals. About the relationship between RE and SD, it can be viewed as a hierarchy of goals and constraints that involve both global and regional or local considerations. Though the exact contribution of RE to SD has to be evaluated in a country specific context, RE offers the opportunity to contribute to a number of important SD goals: (1) social and economic development; (2) energy access; (3) energy security; (4) climate change mitigation and the reduction of environmental and health impacts. The mitigation of dangerous anthropogenic climate change is seen as one strong driving force behind the increased use of RE worldwide

Worldwide governments and people are struggling on one hand for adequate and reliable supply of power and fuels for growth, development and good living standards; on the other hand the impact of energy choices is bringing forth concerns for environment and economic sustainability. In midst of this scenario where our present decisions are liable to influence the developments, lives of many and environment for decades to come, we need to make responsible choices. In this direction, promotion and use of clean energy offers a promising solution along with efforts on energy efficiency and energy management.

With this aim Royal Academy of Engineering has kept a session of Clean Energy in the Symposium. This session aims at knowledge exchange between the experts working in the field of Clean Energy from different parts of the world. The invited speakers are from academia, research fields and industry. Advancements, challenges and possible solutions in utilization of clean energy sources such as solar, wind, biogas, waste heat recovery etc. shall be discussed by the experts in the session.

Session Co-chairs:

Namrata Sengar worked as CSIR- research fellow and was awarded Ph.D. in the field of solar energy utilization, from University of Rajasthan in 2009. Since 2012 she is working as an Assistant Professor at Department of Pure and Applied Physics, University of Kota, Rajasthan in India. She is also coordinator of course M. Tech. (Solar Energy). She is Lead Representative from University of Kota, in Newton-Bhabha Higher Education Partnership Project entitled "Enhancing teaching and research and development in solar energy materials and technologies through capacity building and collaborative research projects".

Mercy Manyuchi is a professional Chemical Engineer and is a research expert in waste to energy technologies, mainly biogas and bio pellets. Dr. Mercy is part of the University of Johannesburg's Bioenergy Technology Research Group, has worked at Harare Institute of Technology as Head of Department in the Chemical and Process Systems Engineering Department, as well as a Lecturer. Dr. Mercy's research interests lie in sustainable technologies that looks at mitigating climate change focusing on biomass renewable energy. Dr. Manyuchi is an alumni to the prestigious German Green Talents Fellowship and the Africa Prize for Innovation. Dr. Mercy is also part of the World Energy Council Future Energy Leaders.

Speakers:

Christos Markides, Imperial College London: After a PhD in Energy at Cambridge, Christos co-founded a spin-out to develop a thermally-powered fluid-pumping technology. In 2008 he was awarded a RCUK Fellowship and appointed Lecturer at Imperial. He became Senior Lecturer in 2014 and Reader in 2016. He heads the Clean Energy Processes Laboratory numbering ~35 students/staff.

Urbain Nzotcha, Africa Group-Co Plc: Urbain is a Cameroonian engineer working for AFRICA GROUP-CO Plc and is Energy Researcher at the National Advanced School of Engineering. He has experience as consultant & innovator in energy access and sustainable development. At the World Energy Council, he is "Future Energy Leader" and member of Solar Knowledge Network.

Beatriz Fidalgo, Cranfield University: Beatriz is lecturer in Clean Energy Technology. Her expertise is in the thermochemical and thermocatalytic conversion of conventional and renewable carbon-based fuels (biomass, coal, petroleum fractions), with particular interest in microwave-induced processes. She is currently working on the conversion of biomass for the production of bioenergy, biofuels, and chemicals, and to microwave biorefining.

Pranav Gadhia. Excellent Renewable Pvt. Ltd. Pranav serves as Vice President of Excellent Renewable Pvt. Ltd. and has eight years of experience in Gadhia Solar Energy Systems Pvt. Ltd. He also headed the installation of many Solar Steam Cooking systems and he also headed the installation of the world's Largest Solar Steam Cooking System. He has done his bachelors degree from Mumbai University.

Presentation Abstracts:

NEXT-GENERATION HIGH EFFICIENCY SOLAR AND WASTE-HEAT CONVERSION TECHNOLOGIES, Christos Markides

By 2050 solar technologies are projected to deliver the majority of the world's electricity, while in the interim concerted efforts will continue to be made so as to utilize fossil fuels as efficiently as possible; in particular, global waste energy in the form of rejected heat to the environment currently accounts for about 250 EJ or 60% of all consumed primary energy. In the case of solar, hybrid PV-thermal (PV/T) collector technology uses a contacting fluid flow that cools the PV cells, thus increasing their electrical efficiency while delivering a useful thermal output (hot fluid stream), and offers advantages when there is demand for both heat and power, and space is at a premium.

Although both solar energy and recovered waste-heat can be used to provide hot water/steam or space heating and electrical power, as well as cooling if required, by far the most common use of the thermal output from PV/T systems and of recovered waste-heat is to use this either directly to provide hot water or steam, or in heat-integration schemes in industrial applications. Nevertheless, a wide range of opportunities arise at higher temperatures, when power-generation or cooling cycles can be employed. These additional options become viable at temperatures typically above ~80 °C, and importantly, become increasingly efficient at progressively higher temperatures. Operating solar panels efficiently at these temperatures is a significant scientific and engineering challenge, since the two modes of heat-transfer loss that reduce their performance, namely convection and radiation, are both exacerbated at higher temperatures, and efforts are being made to alleviated these losses inevacuated-collector designs with optimized surfaces and selective coatings.

Similarly, a significant interestexists in improving the technoeconomic performance and value proposition of power-generation systems based on organic Rankine cycles (ORCs) whose current payback times need to be significantly reduced in order to enable the widespread uptake of this technology, including work on the design and use of novel working fluids (including mixtures) and new expander technologies, targeted specifically at the application temperatures and scales of interest. This talk will discuss recent advances in PV/T and ORC technology for high-efficiency conversion of generated or recovered heat to useful power in these applications.

HOW RECYCLING WASTE FROM TIMBER INDUSTRY FOR ENERGY PRODUCTION CAN CONTRIBUTE TO SUSTAINABLE DEVELOPMENT IN SUB-SAHARAN AFRICA, Urbain Nzotcha

From literature review on Renewable Energy for Sustainable Development, trends are for more decentralised energy systems. Further, forest and wood processing residues look to be the most affordable clean energy source for people living far in forest areas without access to electricity, as is current in tropical regions, especially Sub-Saharan Africa. With regard of this, the presentation first of all provides some elements reinforcing the position of waste wood as a renewable energy source. Secondly it seeks to draw attention to advantages of timber industry waste or by-products, from the perspective of sustainable development, considering the three-pillar model (Economy, Ecology and Society) in which it has been framed traditionally. Doing this, a case study is taken from Cameroon, with a medium size wood processing industry in Cameroon that treat yearly 21,000 m3 of timber producing small sticks for matches manufacture. It has been found that the factory's waste deposit, estimated yearly at 6,366 tonnes, could be treated onsite covering 7800 MWh of thermal needs. This would generate 2246 MWh electricity, with at least 797 MWh exportable to the grid and avoiding carbon emissions by 159 tCO2e. So the energy recovery from the factory's waste could increase the profitability of the facility, allow access to electricity for neighbouring communities or feed the centralised grid on which the plant is connected, while preventing climate change. From these results, wood-producing countries could meet a substantial share of their decentralised electrification needs by opting for systematic energy recovery from wood processing factories waste.

MICROWAVING THE BIOECONOMY, Beatriz Fidalgo

The bioeconomy strategy set by many countries across the world, including the UK, is based on the sustainable use of bioresources (biomass and waste) for tackling interconnected grand societal challenges: ensuring security of healthy food, reducing dependency on fossil fuels, mitigating climate change, and creating jobs. The bieconomy is built upon the concept of integrated biorefining, which entails the sustainable conversion of biomass into a broad range of marketable products. However, the bioeconomy is not consolidated, partly because most of the advanced biobased conversion technologies which comprise the biorefinery scheme are not commercial yet.

Starting from the premise that biobased conversion technology has encountered technical bottlenecks because its development has been approached to resemble fossil-based technology, I will put forth the hypothesis that microwave-based process heating systems have the potential to unlock novel conversion routes and new building blocks. I will explain how microwaves can enhance process rate, conversion, and selectivity of targeted products, and lead to intensification of relevant biorefining processes.

The short- to mid-term aim of my research is to demonstrate that microwave biorefining has the potential be the disruptive innovation that helps to develop and establish technically and economically feasible processes based on renewable biological resources, and to transform the current paradigm based on petroleum refining.

SOLAR CONCENTRATOR TECHNOLOGY, Pranav Gadhia

In India Solar Concentrator technology was introduced by Gadhia Solar, a company I was Director in, along with my Aunty Dr Shirin Gadhia and Uncle Deepak Gadhia who were instrumental in bringing Seifert Parabolic Solar Concentrator for domestic cooking and Scheffler Concentrator for community and institutional cooking. Our company went on to become one of the largest in the world to offer solar cooking based on Scheffler Concentrator. Through Power Point, I will share the evolution of Solar Concentrator technology in India, share some case studies and its economics, details government support and also share some slides on different Solar Concentrators that have now appeared in the Indian market, offering diverse technologies to suit individual site requirements.

I will also share how Biogas technologies projects have been acquired and implemented by the Company MSA Bio-Energy Pvt Ltd, a company I am a CEO to. I will share how one of India's first Biogas Project was conceived and implemented at Muni Seva Ashram, a NGO where biogas is enriched by removal of CO2 and bottled at 200 bar pressure, so that it could be transported to sites far away and used as Bio-CNG, not just for cooking but also to drive vehicles.

Will share future and contribution these technologies offer to India and opportunities it offers not just for cooking but also for process heating, cooling, desalination, drying and for organic farming.