**Saturday, October 22, 2016 09:00AM - 12:00PM**

**Session B; Solar Energy, Crystal Hall B**

**Session Chair: Ehsan Ellahi Khawaja, University of Management and Technology**

**9:00AM B.01 Muhammad Ayaz, U of Balochistan, Pakistan, *Dye sensitized solar cell using Potassium Permanganate (KMnO4) as dye* ―** Research on dye sensitized solar cell (DSSC) massively growing around worldwide due to a perspective of low cost and eco-friendly ability toward green and renewable energy source. In this study DSSC is fabricated by using FTO glass substrate which acts as photoelectrode, TiO2 used as a semiconductor. KMnO4 employed for the absorber of photons from sunlight having bandgap 2.26 eV and wavelength at 549 nm, electrolyte (iodide/tri-iodide) was used as the mediator for dye regeneration and FTO for counter electrode. DSSC photoelectrochemical main parameter attained such as short circuit current (Isc) 0.01mA, open circuit voltage (Voc) 0.416 v, fill factor (FF).The power to conversion energy obtained under sun irradiance.

**9:12AM B.02 Naeem Abas, Nasrullah Khan, Aun Haider, U of Gujrat, Pakistan, *Thermosiphon Solar Water Heater Using Supercritical CO2 as Working Fluid* ―** A gravity driven thermosiphon solar water heating system is developed to harness solar insolation in low sunshine regions. CO2 refrigerant exhibits supercritical heat transfer properties at 7.38MPa pressure and 31.1οC temperature. This solar water heater harnesses solar energy by fitting U shaped copper heat removal pipes in evacuated glass tubes. This system works automatically by natural thermosiphon circulation force caused by density difference of CO2 at different temperatures. CO2 refrigerant easily attains 75οC during 30 to 35C ambient temperatures. When the hot refrigerant is passed through shell-and-coil type counter flow heat exchanger the inlet water temperature increases from 26 to 55 giving off temperature gradient of 29οC. Maximum temperature difference in heat exchanger is 52C. Solar insolation acts as driving force starting thermosiphon effect in CO2. This system provides 23C greatest temperature difference (GTD), 14C lowest temperature difference (LTD) and 18.13C log mean temperature difference (LMTD). Special arrangement in manifolds and inside the evacuated tubes makes it possible to stop reverse thermosyphon. This innovatory solar water heater can perform in subzero temperature areas where water based systems cease to function after freezing.

**9:24AM B.03 Muhammad Muneer Ahmad, NARC Islamabad, Pakistan, *Emission of CO2 from Agricultural Water Pumping and performance of Solar Photo-voltaic Pump in Pakistan* ―** Emission of CO2 from Agricultural Water Pumping and Performance of Solar Photo-voltaic Pump in Pakistan Indus basin irrigation system was designed for an annual cropping intensity (i.e. yearly cropped area) of about 75 %. At present, the cropping intensity varied 200 to 300 % in some regions of Pakistan. Farming communities are using groundwater to fulfil the food and feed requirements. Groundwater plays an important role in Pakistan and more than 50 % of the irrigation water requirements of crops are met through this resource. Generally, pumps are used to relocate water from the source which may be underground or from surface water bodies (ponds, lakes, river, stream, etc.) to its ultimate consumption point which may be livestock, field crops or domestic overhead tank. Realizing the benefits of groundwater irrigation, the trend of groundwater use increased. The numbers of private tube wells were 10,000 in 1960 and increased to 0.60 million in 2002 and at present these are 1.2 million. In the last 40 years (1976-2016), the groundwater contribution to irrigated agriculture has doubled from 25.6 to 50.2 MAF. The energy requirements were also raised with the rise in usage of groundwater. In 2016, the total number of tube wells in Pakistan has reached to 1.2 million whereas diesel operated tube wells are nearly 01 million. The data analysis shows that average annually CO2e emission is 5.025 million metric tonnes from these agricultural water pumps. Pakistan has been seriously struggling with conventional energy sources since 2005. Agriculture sector is also affected like other sectors and performing sub-optimally. It is estimated that about 3000 sunny hours are available in Pakistan during each year with an average insolation of 5-7 KW/m2. A solar PV pump of 5 HP was installed on a reservoir to irrigate 13 acres farm land in Potohar region and the performance evaluation was carried out. The solar pump was monitored for 20 months on three randomly selected sunny days from morning to evening in each month. Every day, the radiations on PV systems and pump discharge were measured. The incident solar radiations at the Fatehjang study site were analysed from Oct 2012 to Sept. 2014. The solar radiation was 4.68 KW/m2 during summer months and 2.78 KW/m2 during winter months of the study duration. The average discharge of solar pump was 5.73 lps during 09 am – 03 pm and 4.07 lps before 09 am and after 03 pm during sun hours. The average discharge of whole day was 5.23 lps and it was 29 percent lesser than high radiation time and 22 percent higher than low radiation time. This shows that a good reliability of solar pump discharge for both high and low radiation time during the day. Development department like Agency for Barani Area Development (ABAD), Punjab has providing subsidy for installation of solar pumps on 200 mini dams in the Potohar area, Punjab. Moreover, Punjab Govt also announced 20,000 solar drip systems in 2016-2017 budget and KyberPakhttoonkhaGovt already installed subsidized 100 solar pumps during 2015-2016. Prime Mnister of Pakistan also announced 30,000 mark-up free solar pumps scheme. The data analysis shows that more than 5 % CO2e emission in water pumping for irrigation will be reduced after complete installation of above mentioned solar pumps. Moreover, after complete installation of aforementioned solar pumps there will be a saving of 100 million litters of diesel annually and there will be a reduction of 7.2 billion rupees in the operational cost of pumping per annum.

**9:36AM B.04 Muhammad Shoaib Saleem, Naeem Abas, Aun Haider, U of Management and Technology Sialkot, Pakistan, *Optimization of Heat Transfer Fluid for Solar Thermal Water Heater using TRNSYS* ―** Solar thermal systems are efficient for utilization of solar energy for hot water and space heating applications at domestic level. A Solar Water Heater (SWH) incorporating an Evacuated Glass Tube collector (EGTC) is studied, designed and simulated in TRNSYS software. Efficiency parameters are pointed and a parametric optimization method is adopted to design the system with maximum conceivable efficiency. This part of study presents the selection of refrigerant for heat transportation in SWH loop. A set of 15 working fluids are selected and their chemical properties are taken from REFPROP software. The selected working fluids are tested in the system under study and plots for energy gain and temperature are plotted using TRNSYS. Results showed that ammonia gives peak energy gain value of 7500 KJ/Hr in winter and 8900 KJ/Hr in summer season along 120 oC temperature gain. On the other hand R123 attains lower values of output parameters.

**9:48AM B.05 Safdar Rasool, Naeem Abas Kalair, University of Gujrat, Pakistan, *Prominence of Solar Thermal Technologies for preparation of Hot Water in Distinct and District Heating Systems*** ― The sun is one of the free, abundant and sustainable source of energy. Men have been using solar energy passively for more than hundreds of years as sun is earth’s prime energy resource. Energy from sun is being harvested either as direct solar radiation or indirectly in the form of wind, biomass, hydro and ocean etc. but in this research our focus is on direct harnessing of energy from sun through various types of solar collectors. After recent technological advancements; solar energy has gotten phenomenal importance as improved technologies had lowered its capital cost and had improved its efficiency which was a major problem in past. In this study many technical and solar future potential as a green energy source has been analyzed. Solar water heating is entirely green technology and it has no negative environmental impacts, its use has greatly increased in last few decades because of its sustainability. Main components of solar water heating system like solar collectors, flat plate collectors, evacuated tube collectors, compound concentrator collectors, storage tank, heat exchangers and various working fluids are also discussed. CO2 emission may be reduced to many folds if we shift our heating and cooling load of buildings and industries towards solar heating and cooling systems.

**10:00AM B.06 Syed Muhammad Zafar Iqbal, Affifa Adeeb, Syed Fazal Ur Rehman, Khalid Aalmgir, Khwaja Fareed U of Engineering and Information Technology Rahim Yar Khan, Pakistan, *A simple technique to characterize solar absorber coatings on metal sheets*** ― In this energy conscious age, Pakistan has a great scope to benefit from solar energy. In this paper solar absorber coatings on metal sheets have been studied which are commonly used in solar heat collectors. Commercially available different types of metal sheets were coated with black paints and silica mixed black paints using silk screen method. Some metal samples were also studied which were covered with plastic laminated sheets coated with black paint as solar absorber. The prepared sheet samples were then exposed under solar radiation and variations in thermovoltage with respect to plate temperature, time and angle of incidence were recorded. The results show that Steel plates coated black absorb more heat than other metal coatings. The technique is very simple to characterize high efficient solar absorber coatings that have promising scope for different types of solar collectors. This technique could also be applied to characterize heat capacity to differentiate solar materials such as solid bricks, tiles and glazed sheets used in roof and window structures.

**10:12AM B.07 Muhammad Usman Sardar, Muhammad Imran Ahmad Shah, Ishfaq Ahmad, Jameel Ahmed, Riphah International U Lahore, Pakistan, *Electricity Generation through the Solar Energy Based Electric Grids to Mitigate the Power Shortage in Gulf*** ― Deficit of electricity due to gas shortages in the Gulf Arab States, calls for industrial and social development within their homeland. How elsewhere, the Arab countries for the production of electricity use conventional sources from many years. Depletion of natural gas and commodity prices are being raised along with negative environmental impacts on their usages particularly in industrialized countries. Power generation based on renewable energy resources such as hydro-power, solar, wind, bio-energy and bio-fuels with the integration of wind and solar energies are good alternatives of traditional sources of sustainable energy. Our study presents that environmental friendly solar energy based power grids that can have greatest impact to balance the electricity generation and demand in the form of cumulative distributed generations. Assessing the prospective of renew-able energy sources for electricity being available, solar powered setups of definite ratings are presented in order to meet the current high demand of electricity with reliability and sustainability. The model presented with different power generation capacities and electricity production is based on real time environment Solar energy potential in the Arab world is stable and sustainable. Our study examines the current and future impact of electricity position on renewable based sources in order to overcome the shortage of energy.

**10:24AM B.08 Faizullah Mahar, Balochistan U of Engineering and Technology, Pakistan, *Solar PV Energy Systems for Rural Health Development in Balochistan*** ― In Balochistan rural inhabitants have to undergo serious debacle and faced tremendous depression in fighting the onset of infectious diseases without provision of health clinics. Hundred thousands of infants and children have been victims of varied disease in remote regions of Balochistan province, where access to health care facilities are just “dream without prediction” Childhood vaccination rates are low in the poorest area of Balochistan. This paper, present procedures and main technical aspects that should be considered towards design and utilization of Photovoltaic (PV) energy systems for rural health facilities in developing areas and would suggest the technical and economic aspects to extend health facilities in Balochistan province and improve immune systems with an aim towards enhancing PV energy systems sustainability for rural health facilities in the province.

**10:36AM B.09 Hina Rohi, Ajab Khan Kasi, Samiullah, U of Balochistan, Pakistan, *Dye sensitized solar cell based on ZnO nanostructures*** ― Dye sensitized solar cells had been under researches due to its low cost and easy fabrication characteristic. TiO2 based cells are most efficient. In this paper the possibilities to use ZnO instead of TiO2 are discussed. Hydrothermal method was used to grow ZnO nanorods on ITO substrate. 2.37 % of efficiency was obtained when dye sensitized solar cell was fabricated on the basis of such electrode. Though usage of ZnO in DSSCs gives low efficiency with a comparison to the TiO2 ones. Still the studies on ZnO based DSSCs leads to better understanding of energy conversion in DSSCs.

**10:48 AM B.10 Sunny Katyara, Madad Ali Shah, IBA Sukkar, Pakistan, *Technical and economical evaluation of solar power system designed for commercial purpose*** ― Due to daunting energy crisis in Pakistan, solar power system can be made feasible for supplying electricity to commercial users. But it becomes uneconomical if implemented over existing AC distribution network. Some modifications in other words DC equivalents for all the appliances should be proposed. The inclination towards AC system is its flexibility of step up and step down through transformers to interconnect geographically distributed network for central monitoring and regulation. Since DC system has found to be superior to AC system in context of power consumption and losses. With the growing trends of distributed generation most of commercial consumers are utilizing them to meet their energy needs. Among these sources, the roof top solar modules are most popular ones in today’s market. In this research, the distribution network of Sukkur IBA was analyzed and then its DC equivalents for its all appliances were proposed for reducing the total cost of solar system. The proposed appliances that can deliver the same or higher utility values as those already in use at Sukkur IBA were identified to cut energy demand. For relative analysis, cost of replacement was factored with corresponding capital cost of solar power system.The cost of designing and implementing solar power system with proposed replaced appliances exhibits a significant reduction of 32.32% power demand. Initially the total average energy demand was 6250 watts, which then has reduced to 4230 watts by implementing proposed method.

**11:00AM B.11 Abdul Qayoom Jakhrani, Saleem Raza Samo, Kishan Chand Mukwana, Quaid-e-Awam U of Engineering, Science & Technology Nawabshah, Pakistan, *Performance Analysis of Line Focusing Parabolic Trough Concentrator for Groundwater Desalination*** ― A line concentrated solar distillation unit was fabricated, installed and evaluated. A total of three different groundwater samples were taken from three different residential colonies of Nawabshah city for the assessment and treatment through installed solar distillation unit. The characteristics parameters such as pH, turbidity, total dissolved solids and electrical conductivity of feed (source) water and product (distilled) water was analyzed in the Laboratory. The average efficiency of the system for removal of both total dissolved solids and electrical conductivity was around 99% respectively. The efficiency of the system for the removal of pH and turbidity was low because the groundwater used for the analysis was nearly neutral level of pH. Since, the surface waters are highly turbid because of various dissolved and suspended particulates. The product water after distillation was found to be drinkable as per standards. It was discovered that the overall system efficiency was directly proportional to the intensity of solar radiation and ambient temperature. The installed system produced 3.2 liters/m2/day in an ideal day.

**11:12AM B.12 Abdul Rehman Jatoi, Saleem Raza Samo, Abdul Qayoom Jakhrani, Quaid-e-Awam U of Engineering, Science & Technology Nawabshah, Pakistan, *Study of Temperature Influence on Power Output of Amorphous and Thin Film Solar Modules*** ― The aim of this research was to study the temperature influence on power output of amorphous and thin film solar modules. For that, the system was mounted over the roof of the Energy and Environment Engineering departmental building located at Nawabshah. The temperature level of solar module was recorded using a Taiwan made, Prova-830, Paperless Recorder and power output by Prova 210, PV Analyzer. The data was logged continuously for two months period from November to December, 2015. It was revealed from the analysis that the average power output of amorphous modules was 55.4 percentages and thin films 70.8 percentages against their rated power output. The difference of power output between amorphous and thin film modules was around 15 percentages. It was found from the study that amorphous solar modules performed well as compared to thin film in the examined months. Keywords: global solar radiation, ambient temperature, module temperature, power output, amorphous silicon, thin film.

**11:24AM B.13 Javed Iqbal, Muhammad Irfan, Sana Sadaf, Ijaz Ahmad Bhatti, University of Agriculture, Faisalabad, Pakistan, *Design of efficient materials for Organic Solar cells*** ― Four different D-A-D type of donor materials constituting triphenylamine (TPA) as donor unit, thiophene as bridge, and thiazolothiazole as acceptor moities are designed by employing DFT method. CAM-B3LYP/6-31G (d,p) and TD-CAM-B3LYP/6-31G (d,p) levels were used to calculate HOMO, LUMO energy levels, Excitation energies, absorption properties and charge mobility properties were investigated. Among designed donors, molecule 4 exhibits ideal lowest band gap of 2.21 eV, FMO energy levels and exclusive broad absorption with λmax of 603 nm. The electron-withdrawing substituents result in red shifts of absorption spectra and better stabilities for designed molecules. The calculated reorganization energies of designed molecules suggested as donors are recommended theoretically for solar cells based on the proper match for FMOs between donors and acceptors. The lower values as compared illustrated that these four donors would be favorable for electron transfer and molecule 4 is best one among these with lowest of 0.0177. The calculated Voc of molecule 4 is 1.1 V with respect to PCBM. The designed donors are suitable and recommended for high performance organic solar cell devices.

**11:36AM B.14 Saleem Raza Samo, Abdul Qayoom Jakhrani, Abdul Rehman Jatoi, Quaid-e-Awam University of Engineering, Science & Technology Nawabshah, Pakistan, *Effect of temperature on performance of crystalline silicon solar modules*** ― The purpose of this work was to study the influence of temperature on performance of two crystalline silicon solar modules namely polycrystalline and monocrystalline. For that, the system was installed over the rooftop of the departmental building. The modules were fixed on a rack, facing true south at the slope of 12Â°. The surface and backside temperature of both crystalline silicon modules was recorded using a Taiwan made, Prova-Model 830, and the performance with Prova-Model 210. The data was logged continuously for two months period from November to December, 2015. The results revealed that the average performance of polycrystalline was 70.6 percentages and monocrystalline 63.9 percentages against their rated power output. The difference of performance between polycrystalline and monocrystalline modules was around 6 percentages. It was found from the study that the polycrystalline solar module performed well as compared to monocrystalline in cold weather conditions. It is because the polycrystalline silicon modules have a higher temperature coefficient than monocrystalline. Therefore, polycrystalline silicon module executed best performance in examined months.

**11:48AM B.15 Tareq Manzoor, Muhammad Ayaz Akbar, Zohaib Hassan, Hassan Javed, COMSATS Institute of Information Technology Sahiwal, Pakistan, *CFD Analysis of performance of circular pipe flat plate solar collector*** ― Solar energy is available in abundance but least used energy source of available renewable energy resources. Solar Energy is being used for some household and commercial purposes like producing steam for commercial usage, heating of water to maintain the indoor temperature of houses etc. Water heating requires heat, which is produced usually with burning of fuels (Methane, Gasoline) and these fuels are costly and causes pollution at burning, but if we use solar energy which is available for almost 10-12 hours in almost every country, we can save a lot. This paper attempts to present numerical simulation of solar collector developed for Flat Plate Solar Collector. For the designer of a water heating system, simulation makes it possible to find the optimum design and operating parameters. In the present paper, the computational fluid dynamics (CFD) tool has been used to simulate the solar collector for better understanding the heat transfer capability. The results were obtained by using ANSYS FLUENT software. The objective of this work is to better understand the computational fluid dynamics (CFD) tool with respect to flow and temperature distribution inside the solar collector. These results can also be used for the designing purpose.

**12:00 PM B.16 Shaheen Tayyaba, U of Management and Technology Lahore, Pakistan, *CFD Harnessing of solar energy by Helio-aero-gravity action*** ― The production of energy by helio-aero-gravity action can be explained by choosing a plane area of land where solar radiation is bountiful. The land is covered with some diaphanous material. A solar chimney enclosing an air turbine is set up at the center of canopied land. At the boundary of the patch, the canopy is kept above the ground allowing ample space for the entrance of cold air. The flat patch of land is heated by direct solar radiation entering through diaphanous canopy. When cold air moves over the heated land surface it gets heated. As a result of pressure difference, the heated air rises in the chimney and drives the turbine. The helio-aero plant, in which the height and diameter of the chimney are 200 m and 10 m, respectively and the diameter of the solar collector is 500 m, is able to produce 110 to 190 kW electric power on a monthly average all year. Some parameters, like ambient temperature, height of chimney, diameter of collector, solar irradiance, the efficiency of turbine, which affect the performance of power generation, are analyzed.