**Friday, October 21, Plenary Session 3, 2:30PM – 6:45PM**

**Plenary Session 3: Session P; Room: Crystal Hall B**

**Session Chair: Azhar Iqbal, University of Management and Technology, Lahore, Pakistan**

**2:30PM P.01 Tadhg O Mahony, Finland Futures Research Centre, Finland, *Seeking wellbeing in the pathway of low carbon transition –*** Rising global material consumption and associated greenhouse gas (GHG)emissions are a major stumbling block in the path of low carbon transition and sustainability. Debates on the contribution of income and consumption to wellbeing are accompanied by difficulties in conception and interpretation. The relationships of consumption to human wellbeing are neither static nor inevitable and consumption can be damaging. Sustainable Consumption and Production (SCP) focusses on production efficiency, eco-efficiency and behaviour, but a more fundamental approach can be articulated by the 'double dividend’. This is where enhanced wellbeing and reduced material consumption and emissions occur in tandem. The double dividend requires a multidimensional concept of wellbeing. This is now supported by multiple independent lines of theory and evidence where income and consumption function as supporting actors. While they are necessary, particularly in the case of poverty and deprivation, they are not sufficient to deliver wellbeing and are associated with a range of negative outcomes for society, environment and individual wellbeing. Changing the focus could be facilitated by pursuing 'wellbeing pathways' that balance the priorities between life domains. This approach from personal psychology is linked to systemic change in ‘sustainable development pathways’ and can be supported by public policy.

**2:45PM P.02 Robina Farooq, Saleem Farooq Shaukat, COMSATS Lahore, Pakistan *Reduction of Carbon Dioxide to Multicarbon Covalent Chemical Bonds by Bio electrochemical Process –*** In the competitive world of ours those who have advanced technologies are expected to be more progressive and advanced nations. Quality of education is directly linked with achievement of technological targets in higher educational institutions. One major objective of education namely, cultivation of higher ethical values is often not given its due place.Man’s alienation from universal ethical values, despite a remarkable material development, has not been able to bring peace, harmony and tolerance in society. Tensions conflicts and clashes, at national and international levels have become a common phenomenon.

A peaceful and sustainable development of humanity and a holistic development of humanity is possible if we revisit our epistemic prioritization. This rethinking can lead us to development of a viable strategy for achievement of global peace and co-existence. This paper advocates introduction of a value based approach in higher education and research.

**3:00PM P.03 Khalid Saeed, COMSATS Lahore, Pakistan *Pakistan’s Power Sector : Rebalancing Fuel Mix for Power Generation* –** The paper highlights the critical role of energy in a country’s development, analyses the reasons for the prevailing energy crisis in Pakistan including the unfavorable generation mix ,high technical and commercial losses, poor recoveries ,low efficiency and below cost tariff regime and its impact in acting as a major drag on country’s development effort. The shift in our power generation mix over last 3 decades, with heavy reliance on imported oil and a much lower contribution of cheaper hydel sources has resulted in acute power shortages (6000-7000MWs) and made electricity unaffordable and unreliable. Pakistan’s current power generation mix profile compares unfavorably with other developing countries and has resulted in high cost ofelectricity, need for Government subsidies, persistent circular debt in the energy supply chain and balance of payments deficit. The Paper examines the adverse effect of Pakistan’s successive Energy policies since 1994 while hoping that some recent measures leadto diversification of generation mix alongside induction of renewable energy for power generation .The paper concludes by reviewing various options for future fuel generation mix for the country to ensure its energy security and availability of safe, affordable, reliable and environment friendly power generation.

**3:15PM P.04 Amjad Ali, AEDB Islamabad, Government Power Policies & Status of Power Projects in Pakistan**

**3:30PM P.05 Muhammad Ghaffar Dogar, COMSATS, Lahore *Least Cost Energy Options for agriculture sector in Punjab, Pakistan* –** The problem of power shortage is more severe in rural areas of Pakistan than in the urban towns. About 61% of the people live in rural areas, and 30% of the population does not have access to grid connected electricity. Even if they have electricity, blackouts continue for more than 12 hours per day. Agriculture farms do not enjoy modern electricity supply and farmers operating tube wells and equipment on grid connected electricity suffers the most. The cost of electricity (if available) is high and affects the productivity and profitability of farms. Agriculture sector contributes 21% of the national GDP, employs 45% of the labor force and have major (63%) share in exports but consumes 1.5% commercial energy. Problem of shortage of electricity is severe at farms. Diesel oil and electricity are used for on-farm operations which are performed through tractor and tube-wells. The cost of diesel oil has increased almost by 350% during 2005-14 but slightly reduced later on. The energy cost of a farmer having diesel tube well is 30% + of input costs. Thus if the irrigation cost is reduced the profitability of farms shall increase. Punjab province has the largest canal network in Pakistan.The canal water received at farm gate is 35 MAF/annum (excluding conveyance losses in canals and channels) which is sufficient to maintain only 50% cropping intensity (CI). At 125% CI the shortfall is met by one million agriculture tube wells. Majority of the tube wells (85%) have prime mover <=20 HP. According to Agriculture Department these tube wells pump out 30 MAF/ annum. The electric tube wells are not energy efficient and consume more energy; 40% of the electricity consumed by these tube wells can be saved by introducing energy efficiency measures in electric tube wells. The annual operational cost of one million diesel and electrical tube wells is Rs. 1.50 billion US$. This is a heavy burden on the national economy as well as an expensive option for the farmers. The operational costs of tube wells can be reduced by 30%-40% using solar submersible pumps.

The potential of solar resource base is excellent; bright sunshine spell prevails over 2400 hour/annum and 5.5 KWh of energy is received on each square meter area/day. Solar PV systems are reliable, long life and well tested worldwide and can supply electricity to run the light loads in all economic activities. The solar PV water pumps are imported by private sector and sold to farmers who have no awareness about the quality of products and warranty issues. Solar pumps are costly and its components are not efficiently matched. The manpower involved in solar business is not well trained and needs capacity building for designing, installation and operation and maintenance of the PV systems including solar pumps. Local manufacturing industry of PV systems covering all aspects of the technology has not been established yet. Some business groups/ companies are assembling PV panels using imported cells the quality of which is not certified in labs. Similarly bio gas energy potential is excellent and Punjab Government has introduced bio gas energy for diesel tube wells operation. This has replaced 70-80% of diesel oil consumption. This paper aims at evaluating the energy costs of agriculture farms especially for tube wells and compare the operational costs of bio gas and solar water pumps with conventional pumps and study the viability of least cost technology for 12-25 acre farm. Options to reduce the energy costs have also been discussed.

**3:45PM P.06 Salamat Ali, Government College U, Lahore, Pakistan, *Harnessing the Renewable Energy and its future in Pakistan***

**4:00PM P.07 Abdul Aziz Bhatti, U of Management and Technology Lahore, Pakistan, *Role of Disruptive technologies in the development of Virtual e-education in real time and economic sustainability in developing countries such as Pakistan.***

**4:15PM P.08 Syed Zafar Ilyas, COMSATS, Lahore, Pakistan, *Role of Fossil Fuels in Environmental Damages* –** The rapid growing of energy demand, highly use of fossil fuel &amp; high intensity are the key factors causing harmful impacts on the environment, which cause direct and indirect negative effect, on the economy. The estimated damages caused by each fossil fuel in 1998-2004 are US$ 1000 per capita per year or US$ 7176 billion per year. Engineers and scientist are agreed that hydrogen energy system is the only solution to deal with environmental problems. The study shows the negative effect of fossil fuels only five cities have been taken for the study. It has been shown that the damage adds up to US$ 7176 billion per year. This external casts of fossil fuel use should be added to their existing market price and such real costs should be compared with the real costs of other environmentally acceptable energy alternatives.

**4:30PM P.09 Khalid Islam, Ex-Director General, Pakistan Council Of Renewable Energy Technologies (Pcret), *Setting Up An Indeginous Solar Modules Production Plant In Pakistan: A Great Opportunity For Investors To Serve The Nation* -** Demand of Solar Panels/PV Modules in Pakistan is increasing as the solar power technology has become more popular due to cognitive actions by the Government and private sector. During the FY-12-14, 305 MW Solar Modules, FY13-14 650 MW and during FY-15-16 as much 1200 MW of Solar Modules were imported. These imports are for meeting the demand of industrial Solar Power, Electrification of Solar Tube Wells, Solar Power Solutions for Homes and Offices etc. Amazingly these imports for the FY-16-17 would be more that 2 MW. The bulk imports of Solar PV panels for Solar Farms (in commensurations of 100 MW and above) are separately imported. All such imports are exempted from all types of Govt. taxes and duties. As a consequence of the recommendations made by a high level technical committee vide GoP order No. EDB-PL-01/14-Tech-II, dated: 14-10-2014, this attraction was given to all stake holders for the import of Hi-Quality and Hi-Efficiency Solar Modules for a limited duration. It is predicted that during the FY-16-17 these duties will be imposed back again and prices of Solar Panels will rise to an overall 44 % effect. This paper is as an early awareness call to stake holders who should be looking into this new business opportunity. More that 90% imported modules have efficiency less than (15% for Poly and 15.5 % for Mono Modules). Due to local Quality Assurance factors, and Total Quality Management, locally produced modules by far meet these requirements but their production capacity is less than 1% of total demand. This demand supply gap calls for action: There is an excellent opportunity for local production of Hi-Quality modules. The technology for lamination is so easy that one can establish a complete production plant of capacity 10 MW, 50 MW or 70 MW per annum, just in 30-60 days. Trained man power is already available in the market. The procurement cost of one such complete production plant of 10 MW capacity is around USD 1,90,000 (about Rs.2 crore) with installation, commissioning and operational training by foreign experts. The plant comprises of a total of 82 machines, testers and working benches including: Two Class-AAA Solar Cell Testers, Class-AAA Sun Simulator/Solar Module Tester to test against IEC 61215, Electro Luminance (EL) Tester, Laser Scribing Machine to cut solar cells, 43-feet fully Automatic Laminator for 900 W lamination in 16 minute, multiple solder strip cutting machine, Automatic Framing machine, Module repair machine, 125 Welding Templates,  Solar Cell Sorter, six welding stations, EVA/TPT cutting table, two observational test tables, modules laying tables, modules carrying trucks, storage racks and so on. Whereas all required components, materials and Hi-Quality Solar Cells are available in the international markets at very reasonable rates so that locally produced A-Class Solar Modules give profit margins not less than 10 Cent per watt if compared with imported A-Class modules. The cost of 50 MW and 70 MW production plant is also shared in this paper. Human resource of at least 120 key staff with hands on training for Solar PV Panel production and its database is already available to serve this industry.

Cost analysis showing pay back periods for these plants is included for the interest of investors. For instance cost of a 10 MW production plant is recovered in less than six months if the profit is kept at 2 Cent per watt only. It is highly recommended that indigenous Hi-Quality Hi-Efficiency Solar Modules production should be considered by new investors for this neat, clean and prestigious business which also ensures quick return on investment as well.

**4:45PM P.10 Arifa Tahir, LCWU, *Environmental Implications of burning of crops biomass* –** All energy sources have some impact on our environment. Most energy sources degrade environment, including air and water pollution, damage to public health, wildlife and habitat loss, water use, land use, and GHG emissions. It is important to understand the environmental impacts associated with producing energy from biomass. The development of agricultural biomass systems is associated with environmental risks. Cultivation of Certain sources of biomass, feedstock, is reported to be linked with negative environmental effects such as depletion of land and agro biodiversity. More land space will result in huge amounts of carbon emissions into the atmosphere. We can minimize environmental impact by considering environmental issues associated with renewable energy source.

**5:15PM P.11 Waqar Mahmood, CERAD, U of Engineering and Technology Lahore,*Solar Energy Power Projects in Punjab and Lessons Learned –*** This paper presents an overview of the current Energy deficit being faced by Pakistan and foremost grounds of Energy crisis. It covers a few initiatives and projects accomplished by Punjab Government in renewable energy sector. The significant realizations and outcomes with focus on solar technology projects is the main objectives of paper. In addition, the solar and wind resource mapping potential of Pakistan with reference to the ESMAP has also been highlighted. Paper concludes with recent status and trends of projects in solar and wind domain.

**5:30PM P.12 Muhammad Munir Ahmad, Muhammad Khalid Jamil, Abdul Wahab, Muhammad Asif, Climate Change, Alternate Energy and Water Resources Institute, National Agricultural Research Centre, PakistanAgricultural Research Council, Islamabad*. Emission of CO2 from Agricultural Water Pumping and Performance of Solar Photovoltaic 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 tons 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 lpsduring 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 liters of diesel annually and there will be a reduction of 7.2 billion rupees in the operational cost of pumping per annum.

**5:45PM P.13 Shahid Amjad, Institute of Business Management. (IoBM) Karachi, *Harnessing Ocean Energy–*** The oceans are the largest collector of solar radiations that we receive from the sun. The oceans cover 70 % of our planet earth. The Oceans store energy in the form of heat and generate thermal energy. A 10oC difference in temperature between surface and bottom water can be harnessed using a working fluid. The heat can be converted into electricity by means of a process called Ocean Thermal Energy Conversion (OTEC). Pakistan has the potential for generating Ocean thermal energy from offshore areas. Ocean energy can also be harnessed from the tides and waves. Karachi has a complex network of creeks in the Indus deltaic area of 170 km. Tidal water flows in and out of these creeks with high velocity (0.2-0.5m.s-1) during flood and ebb tides. Preliminary feasibility surveys conducted by NIO Pakistan for the extraction of energy along the Indus deltaic creek system estimates approx. 1100 MW power can be produced from the 17 major creeks. The seawater inundates up to 80 km. inland at some places due to the tidal fluctuation which is favorable for the extraction of energy from tidal currents. Bays along coastal Balochistan also have the potential to generate energy from tidal sources. The advantages for using ocean energy, tidal wave and heat energy over different fossil fuels are plentiful; there are several impressive benefits of using renewable sources of ocean energy. The paper discusses the viability of ocean energy in Pakistan.

**6:00PM P.14 Suhail Zaki Farooq, NUST, *Applications of Solar Thermal Technologies for Pakistan* –** As per estimates, about 2.9 million mega watt power can be generated from solar radiation in Pakistan. This is 150 times more than the current electricity demand in the country. However, the potential for solar thermal applications is even 1000 times more. Solar thermal technologies include solar cookers, solar water heaters, solar water purifiers and solar driers. Each of these technologies has huge potential for further development and adoption in Pakistan. These are cost effective and mature solutions, ready for wide scale dissemination. There is a lot of potential for advanced R&D in this sector. More than one third of the primary energy consumption in Pakistan is accounted for cooking of food. There is a huge market for the deployment of user friendly cooking alternatives like solar cookers, amongst the fuel starved rural population. This market can be tapped through advanced R&D in this area. This paper presents an overview of the above technologies with special emphasis on the scientific performance evaluation and energy and energy analysis of different types of solar cookers, including the box type, parabola type and the vacuum tube type.

**6:15PM P.15 Tareq Manzoor, Mechanical Engineering Department, COMSATS Institute of Information Technology, Sahiwal, *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.

**6:30PM P.16 Amjad Hussain, QA Solar Park, *Prospects and Constrains in Renewable Energy Generation in Pakistan and Best Energy Generation Mix Options***