

Quarterly





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RESE





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Lecture on "Energy Crisis in Pakistan and the way Forward" at the ERC









ERC Lecture Series: Energy Crisis in Pakistan and the Way Forward

The Energy Research Center (ERC), CIIT, Lahore has started a Lecture Series on topics relating to Energy. The Program envisages inviting guest speakers who are renowned experts in their fields. As a part of this program, the first lecture on "Energy Crisis in Pakistan and the way forward" was delivered by Mr. Parvez Butt (Ex-Federal Secretary, Ministry of Science and Technology) on 5-September-2016 at the CIIT Lahore. The Lecture was attended by a large number of Faculty members, researchers and students from various Faculties. Head ERC welcomed the chief guest and introduced ERC and ongoing activities. Mr. Parvez Butt discussed the potential of power generation sources in Pakistan. According to him, Pakistan is blessed with Renewable Energy resources as well as conventional resources like coal and Nuclear power. While discussing the major causes of present energy crisis of Pakistan, Mr. Parvez Butt emphasized on generation using coal and renewable energy. Lessons learned and success stories of the Atomic Energy Commission and the Chashma Nuclear Power projects were also discussed in the lecture followed by the proposals for mitigating the present energy crisis of Pakistan. The faculty members and students, at the end of the lecture, actively engaged in a Q&A session. Later, Mr. Parvez Butt also had a meeting with the Director CIIT Lahore in his office along with the Head, ERC and expressed his appreciation for the research related activities at CIIT.

ERC Seminar on Solar Energy Promotion in Pakistan: Potential Utilization and Constraints

Keeping in view the importance and great potential of solar energy in Pakistan, COMSATS Energy Research Center arranged a seminar on "Promotion of Solar Energy in Pakistan: Potential, Utilization and Constraints" on 26th September, 2016 at IRCBM seminar room. The seminar was arranged in collaboration with the Dynamic Green Private Limited. The seminar was attended by a large number of private and public sector organizations/Universities, faculty members/researchers and students of various faculties. Speakers from the Alternative Energy Development Board (AEDB), National Electric Power Regulatory Authority (NEPRA), Pakistan Agriculture Research Council (PARC), Quaid-e-Azam Solar Park, University of Engineering and Technology Lahore, Agriculture Department Government of Punjab, FAST NU, COMSATS faculty members and Dynamic Green's experts read out their papers in the seminar.

Mr. Khalid Saeed, Head Energy Research Center inaugurated the session and highlighted the significance of solar power in Pakistan, it's utilization and limitations. He presented the current scenario of Pakistan's energy sector. Pakistan relies heavily on oil imports for its power generation which is a costly option. While discussing the significance of solar power in Pakistan, Mr. Khalid Saeed underlined the enormous potential of solar power in Pakistan. He stated that the promotion of Renewable Energy sources including the solar and wind power are essential to diversify and rationalize Pakistan's fuel mix for power generation. Apart





from abundant availability, the solar power have the benefit of reaching far flung areas not linked to the national grid. Another important factor discussed was the projected declining cost per watt of solar energy over the years. Discussing the disadvantages, intermittency of solar power that restricts its utilization as base load was the main constraint followed by larger area required for its installation. Mr. Aqeel Jafri, Director Alternative Energy Development board (AEDB) presented the current status of government policies. Mr. Aqeel highlighted the major points of 2006 power policy where net metering for distributed power generation, zero income tax on renewable power equipment purchases, fiscal and financial incentives were the main points. Discussing the present status of solar power projects in Pakistan, 956.52 MW of solar power projects in the country are in pipeline whereas four projects covering 400 MW are operational and 75.2 MW projects are achieving financial closing. Strategies of solar power development in rural areas were also briefly discussed.

Mr. Muhammad Amjad, CEO, Quaid-e-Azam (QA) Solar Park discussed the development of solar power, lessons learned and future pathways. Mr. Amjad stated that Solar and wind power are the best combination for developing a balanced supply mix. Discussing the power sector of Pakistan Mr. Amjad put emphasis on the less utility of fossil fuels due to associated financial challenges. Mr. Amjad also discussed the present power generation of Quaid-e-Azam solar park and its future phases. Mr. Muhammad Yousf, Deputy Director Tariff from National Electric Power Regulatory authority (NEPRA) introduced NEPRA's vision and framework. Proposed up front renewable energy tariff rates for North and South regions of Pakistan were also discussed whereas it was also stated that distributed generation and net metering regulations has been approved by NEPRA.

Dr. Waqar Mehmood, Director, Center for Energy Research and Development (CERAD), UET Lahore discussed solar energy projects in Punjab and lessons learned. Dr. Waqar Mehmmod presented a detailed analysis of causes of energy crisis in Pakistan. Key points discussed were that the electric power sector remained in static non-growth mode from 2003-2010 and the peak supply-demand gap grew substantially. The demand - supply gap in gas sector emerged in 2007 and has grown as existing gas wells get depleted and no new exploration is made. Inadequate energy infrastructure, inefficient/ limited supply to end customers and short supply of gas/oil to power plants remained major constraints

Dr. Sohail Zaki Farooqi, Ex-Director General Pakistan Council of Renewable Energy Technologies (PCRET) discussed the barriers to Solar PV manufacturing in Pakistan. Dr. Sohail Zaki discussed manufacturing process of solar PV technologies. Market shares and prices of different technologies were also discussed.







Mr. Mudassar Khan an expert from Dynamic Green Private Limited discussed the international road map for PV technologies. Different PV cell technologies like mono-crystalline, poly crystalline, their manufacturing, efficiency and factors for efficiency degradation were presented. Mr. Mudassar gave a detailed analysis of financial and technical evaluations of the solar PV technologies around the globe.

Dr. Munir Meher, Chief Scientist/Director General, Pakistan Agricultural Research Council (PARC) discussed solar thermal technology that is used for date drying. High moisture contents in dates decrease the quality of the overall yield. To overcome this problem date's dryer; a solar thermal technology for drying the yield is best possible option. Two dryers solar cum gas dryer and solar tunnel dryer were discussed in detail. Both the types are available and tested at PARC. Engr. Saleem Barg from Barg Engineering, a private renewable energy consultant discussed the solar power projects in Khyber Pakhtunkhwa (KP) and future road map. KP solar projects initiatives like Solar Pumping (Irrigation & Agriculture Departments), Street Lights, Off Grid Kits for FATA & Electricity Energy Deprived areas, Government offices Rooftop Buildings, Rural Electrification, solar solution drinking water schemes, Hospital (BHU's in planning phase), Schools (in planning phase) were discussed in details.

All the important features in PV technology like overview, technological advancements; international and national solar PV installation, PV production, policies and regulatory affairs were discussed in the seminar. Important policy developments and regulatory affairs were discussed in detail among the experts.







ERC project on "Basic Research and Capacity Investigation for Distributed Bioenergy Utilization via Thermo-chemical Conversion "approved for funding from Pakistan Science Foundation and Natural Science Foundation China

Under the Memorandum of Understanding between National Natural Science Foundation of China (NSFC) and Pakistan Science Foundation (PSF), NSFC and PSF invited joint proposals of R&D from Universities, Research Centers and Institutes in March-April 2016. The COMSATS ERC interacted with all Faculty /Researchers at COMSATS eight campuses and encouraged them to submit proposals on energy. A number of proposals were submitted by different faculty members on energy subject mainly from CIIT Lahore, including projects by Dr Muhammad Ghaffar Doggar, PSO, ERC and Professor Dr. Robina Farooq from the Chemical Engineering Department. The project entitled "Basic Research and Capacity Investigation for Distributed Bioenergy Utilization via Thermo-chemical Conversion" has been approved for funding.

Dr. Muhammad Ghaffar Doggar is the Principal Investigator from CIIT Lahore with Dr. Chuangzhi Wu from Guangzhou Institute of Energy Conversion (GIEC), Chinese Academy of Sciences. The project cost is Rs. 8.1 million (Pak Side) and 3 Million Yuan (China side) and the implementation period is 36 months. The project aims at study of physio-chemical properties of biomass feedstock in Pakistan and exploring suitable pretreatment options and techno-economic feasibility of distributed bio energy utilization technologies. Research on high quality syngas production from biomass gasification and low emission combustion of biomass and bio-syngas for heat or power generation will be conducted. Further, design of equipment, mathematical modeling and studying design parameters and making calculations covering all aspects of equipment development shall be part of project activities. Testing of prototypes of suitable sizes (using locally available Chinese models) and evaluating their techno-economic feasibility in field, both in China and Pakistan shall also be ensured. Training of man power (3-4 CIIT professionals) for local development of equipment (10-20 kW) and its efficient usage in field and awareness campaigns are the integral part of the project activities.







Power Sector Crisis: Moving Towards a Solution?

Khalid Saeed Head, COMSATS Energy Research Center

Energy is now considered as the oxygen of an economy and the life line of economic growth, particularly in the industrlisation stage of emerging economies. Various studies have confirmed a strong relationship between energy availability and economic growth in case of Pakistan. Thus, periods of high growth of energy availability coincided h higher growth rate of economy and vice a versa. Likewise, there is a significant positive relationship between energy consumption and economic growth. Pakistan's power sector has been in the news, though mostly all for bad reasons, over the last few years. The load shedding resulting from a supply-demand gap of around 7,000-8,000 MWs has dealt a severe blow to the country's economic growth. An expensive fuel mix for power generation, un justifiable transmission and distribution losses mainly due to poor infrastructure, theft, corruption and misgovernance have created a serious energy crisis in the country. Coupled with the poor recovery of the electricity bills, the below cost tariffs have put a huge burden on the national exchequer. Government's inability to fully pay the difference between the cost of electricity and the NEPRA approved tariff to the Distribution Companies resulted in nonpayment to fuel suppliers and the infamous circular debt in the energy supply chain. The Government, with its 2013 election promise of ending the load shedding now claims to be on track for adding around 10,000 MWs of additional electricity by end 2018 or earlier, which will substantially eliminate the need for any load shedding. It is also planned to more than double the total generation capacity over next 5 years from the existing 23,000 MWs. This additional power includes the recently commissioned CHASNUPP 3 Nuclear Plant (340MWs), to be followed by CHASNUPP 4 adding another 340 MWs of nuclear power in the next few months and raising nuclear power's contribution to around 11% of total generation by 2021 after the commissioning of two Karachi based plants.

The hydel generation from long awaited completion and commissioning of Neelum Jehlum (960 MWs) and Tarbela extension phase 4 (1,410 MWs) along with a couple of smaller hydel projects is expected to add 2,500 MWs to the system over next two years. An additional 3,000 MWs of hydel power is also being pursued and could contribute more over the next few years.

After many hiccups, finally, we are also getting the imported Liquefied Natural Gas (LNG) to augment the depleting domestic gas resources, albeit at a price much higher than the indigenous gas. Around 3,600 MWs of electricity is planned to be generated through the LNG over next few years. Coal based generation is also expected to add around 6,000 MWs to our generation over next 2-3 years. The expected generation capacity from early 2018 is expected to stay ahead of the projected peak demand for the next few years.

Apart from increase in total generation capacity, significantly, the future fuel mix for power generation is





being rationalized and is expected to reduce the cost of electricity as well. Last year, furnace oil and diesel accounted for 36% and gas and hydel generation 29% each in our total generation. The share of hydel power, which is the cheapest source, has drastically dropped from over two-third in the mid eighties to less than one third last year in our power generation. The choice of the source of generation is important for the consumer due to its impact on the cost. The oil based generation, currently making over 1/3rd of our generation produces the most expensive electricity. In 2014, the cost of oil based electricity was at Rs.16 per unit compared to less than Rs.5 for gas, Rs. 4 for coal and just over Rs. 1.50 for hydel and nuclear based generation from the existing plants.

Despite the clamor about its deleterious environmental impact, coal accounts for over 40% of global electricity generation. Its share in USA, China and India's power generation ranges from 49 to 69%. Coal based power is conspicuous by its almost total absence from Pakistan's power generation. Despite being endowed with one of the largest coal reservoirs in the world, Pakistan never opted for using coal as a fuel for generating electricity. However, now we are also going in for coal based generation projects which are expected to contribute around 6,000 MWs over next 2-3 years. These include projects using both the imported coal as well as Thar Coal.

Our planners had erroneously assumed the availability of abundant and unending supplies of natural gas, a cheaper and cleaner fuel. The shortages of gas and load shedding over the last decade did not deter the successive governments from freely allocating it out of political expediency, for transport and domestic sectors at the cost of industry and power sectors. Such short-sighted and adhoc gas allocation policies have resulted in a declining share of gas based electricity for the consumers. During the last 15 years, when gas shortages had already become known to policy makers, over 5,000 MW capacity based on oil/gas was added to the system in Pakistan. Over the same period, 50% incremental generation capacity being added around the world was coal based. We had to pay dearly for this omission and now this is being rectified. The induction of cheaper coal based generation is expected to contribute around 18% to our generation in next 3 years as against less than 1% now. Similarly inducting imported LNG, though not as cheap as the domestic gas, is a welcome addition and will remedy the gas shortages. Our past energy sector policies led to a lopsided power fuel mix that is 1/3rd of power based on expensive imported oil, which, the world over is only used to produce around 14% of power. Furnace oil and diesel (HSD), two most expensive fuels for power generation, accounted for 36% of our electricity generation in 2015-16. The latest studies indicate that over next 20-25 years, the share of global oil based power generation will be reduced to 2% only.





	Ave Cost of Generation (Rs/Kwh)		Total Generation (in 000 Gwh)		% age Share in Generation	
	FY14	FY15	FY14	FY15	FY14	FY15
Hydel	-	-	32.2	32.6	32.9	32.5
RFO	16.0	12.4	36.0	31.7	38.5	33.2
Gas	4.8	4.7	19.0	22.5	20.1	23.3
HSD	22.2	17.4	1.6	2.9	1.7	3.1
Coal	4.0	4.5	0.1	0.1	0.1	0.1
Nuclear	1.3	1.2	4.4	5.0	4.8	5.4
Import Iran	10.2	10.1	0.4	0.5	0.4	0.5
Mixed	9.3	8.2	0.4	0.5	0.4	0.5
Wind	-	-	0.3	0.5	0.3	0.5
(Avg/Total)	7.7	5.9	95.2	96.7	100	100
Transmission losses	0.2	0.1	-2.3	-2.1	-	-
Net delivered	8.0	6.1	92.8	94.9	-	-
FPA Variation (Rs/Kwh)	2.8	-1.8	-	-	-	-

Pakistan: Power Generation by Source and With Cost

Globally, a major shift in the power generation fuel mix, both in the developed and developing countries, is under way whereby the Renewable Energy is growing at a much faster rate than the fossil fuels based energy. According to the Energy Outlook, renewable energies will be contributing 37% to the world's energy production. Renewable based energy's growth is expected to outperform the growth in fossil fuel based generation by 2040. The inclusion of wind and solar power in Pakistan's power mix is also a very timely step in line with the global trends. Pakistan has the potential for 2.9 million MWs of solar energy and 60,000 MWs from wind energy. Solar based mini distribution networks offer promising and affordable electricity even in the far flung areas. Energy Policy 2015 has aimed at 5% share from the Renewable Energy resources in our power generation. In addition to 400 MWs already commissioned, another 600 MWs of solar power from QASP project are to be connected to the national grid. AEDB has claimed that Pakistan's Renewable power generation has already crossed 10,00MWs. However, the Cabinet Committee on Energy's decision to stop any further solar or wind based projects runs counter to the global trends and needs to be reviewed in view of significant reductions in the cost of renewable energy projects. Any future fuel generation mix must be diversified, reliant on cheaper indigenous fuel resources and meet the criteria of reliability, affordability and safety in addition to its environmental impact

The induction of additional nuclear and hydel power, alongside coal and LNG based generation will result in a far more diversified and cost effective fuel mix. The heavy reliance on imported furnace oil and diesel, subject to the vicissitudes of international oil price fluctuations will be reduced to less than half of its current levels in the overall generation. Coal and LNG will become significant contributors to our future power mix, while solar, wind and biomass based power will also be harnessed in more earnestness.

The electricity consumers, in addition to an uninterrupted and reliable power supply, will be keenly looking





Pakistan's Current and Projected Fuel Mix for Power Generation:

forward to benefit from the reduced cost of electricity with these shifts in our power generation mix as promised in the Power Policy of 2014. The average per unit cost of electricity generation registered a decline from Rs. 10.59 per unit in 2014 to Rs. 9.84 in 2015. With the substitution of imported oil with coal, LNG, hydel and nuclear over next 2-3 years. The average generation cost of electricity should register a more permanent and sustainable decline, not dependent only on international oil prices. The reduced generation cost benefits can, however, be passed on to the end users only if the bleeding and hemorrhage of the power sector due to poor governance and corruption is controlled. The financial health of the power sector cannot improve unless huge leakages through transmission and distribution losses and non-recovery of dues are plugged. The recent observations of the power sector watch dog (NEPRA) castigated the Government for its failure to ensure the least cost generation by running less efficient units, while letting the more efficient and cost effective units to be starved of the fuel. Another serious hurdle in the plans seems to be the refusal of the Chinese investors to accept the tariff allowed by NEPRA for Matiari-Lahore Transmission line, which is crucial for evacuating and conveying the additional power to the load centers. The recent past record of unfulfilled promises like the Gadani Power Project Park or the failure to ensure expeditious commissioning of the ill-fated Nandipur power project and inexplicable delays in the finalization of approvals for some already pending projects are not encouraging signs and may throw a spanner in the works in realizing the dream of a load shedding free country in next 2 years. It is hoped that Government will resolve these issues soon and ensure that the electricity shortages are no more there in next few months. A lot of work, however still remains to be done for ensuring a sustainable and robust financial model for the energy sector.





Introduction to Microgrids: A Futuristic Power Systems Approach

Engr. Fawad Azeem Lecturer Energy Research Center Lahore

Introduction:

Today, Energy consumption per capita has increased globally. World's bank data for energy consumption per capita shows ever increasing trend of kWh/per capita from 1971-2013. This increasing trend made the conventional power systems exhausted. Further, environmental concerns with the conventional fossil fueled generation are topmost. Existing power infrastructure cannot be extended due to increasing population. This creates no way out situation for the utility companies (Power transmission, Distribution and Generation). To overcome the increasing demand while satisfying environmental conditions, renewable energy resources are the best feasible option. Generation through renewable energy resources satisfies environmental conditions while its installation to the near load reduces losses. Such systems that are near to the load and support the defined load are known as microgrids.







What is a Microgrid?

A Microgrid, as its name implies is a mini low voltage grid having defined loads and generation sources. Mostly these generation sources are Renewable Energy based like Solar, Wind etc. The system can support the defined load using inverter interfaced generation system and storage or it can also be connected to the main stream network using point of common coupling (PCC). PCC is a point where power from renewable energy based generator connects to the main grid. Once the grid is connected to the main grid network, it is known as Grid-Connected Microgrid. On the other hand during islanded operation i.e. not connected to the main network is known as Islanded Microgrid. In Islanded option frequency and voltage is stabilized by grid itself using state of the art control techniques. During grid connected mode the microgrid follows the frequency and voltage of the main stream network.

Microgrid Implementation Worldwide

A microgrid is among a growing field of international technology market. In the U.S., the market is pegged at just over \$550 million and is expected to exceed \$1.3 billion in four years, according to GTM Research. Below given highlighted areas are the single-user, single-user/community, rural electrification and islands.









"As of 2014, Navigant Research has identified a total of 4,393 MW of total microgrid capacity throughout the world, up from 4,148 MW in the previous update in 2013. North America is the world's most fertile environment for microgrids due to the declining reliability of its distribution grid. It is World's leading market for microgrids with a planned, proposed, and deployed capacity of 2,874 MW, which represents roughly 66% of the global microgrid market."



(http://newenergynews.blogspot.com/2014/04/microgrids-rising-around-world.html)

Microgrids Pakistan Perspective

Pakistan is among the countries that exhibit enormous renewable energy potential. Despite enormous power potential available. Pakistan faces 5,000 to 7,000 MW power shortfalls during summer. This power shortfall will increase since as overall demand is increasing. On the other hand Pakistan's power sector infrastructure cannot be extended anymore. To overcome this demand and supply mismatch, microgrids are the best possible solutions. Below map shows the renewable energy resources available at provincial level. While installing power plants of these resources, and connecting it to the main stream network will relive the conventional power plants. Not only this distributed generation will contribute to national grid but it can also work in islanded mode in case of power disturbance in the upstream network. Further, such villages and military locations where national grid is not accessible, islanded microgrids can be installed.







Conclusion

Since installation of microgrid is an evolutionary step and is best option for the countries like Pakistan that contains enormous renewable energy potential. Distributed generation is key to the future power station and world is adopting it to fulfill future energy needs while satisfying the environmental constraints. At domestic level, in Pakistan, research and development and practical training is required to handle the challenges associated with these microgrids to ensure reliable operation. Professional training of distributed and generation companies Engineers and Technicians may be conducted to adopt microgrid technology. Further there is need to change the power sector policy for Renewable power generation. Microgrids must be the part of Pakistan's power policy.





Crisis of Energy or Crisis of Attitude?

Qasim Khokhar

Managing Director, Punjab Energy Efficiency and Conservation Agency (PEECA)

"Sustainable energy is the golden thread that connects economic growth, increased social equity and an environment that allows the world to thrive " said Ban ki moon, the Secretary-General of United Nations. Energy is a backbone of civilization and whatsoever has been achieved by the journey of civilization is through energy . Humans have been harnessing more and more forms of energy and making the life on planet better. But lack of respect for this bone of human civilization by masses, some industries, irresponsible commercial activities, Pakistan is facing an Energy crisis and has landed into a vicious cycle. Its energy needs are multiplying for increasing population, urbanization and modernization. There is another dark side to Pakistan's Energy crisis which has limited its growth and has made more than 4.1 million people unemployed. This unemployed youth is slipping into hands of Extremists which are re-employing them to spoil law and order and further retarding growth , so on and so forth. Thus energy outages are seriously hampering government's strategy to eradicate poverty which in turn breeds extremism and violence in the society at large and slums in special . And to add fuel to the fire, all this is happening at a time when we are fighting a war of survival of our values and against terrorism in FATA and parts of KPK.

There is another dimension of this crisis, it is leading to poor law and order situation which is discouraging Foreign Direct Investment and private investment in the sector which ultimately leads to more outages and load shedding. Further, as precious resources are diverted towards war against terrorism and in garrisoning our schools, offices, universities, markets and cities, so little fiscal space is left with Government to invest in energy infrastructure. The dwindling investment again encourage extremism.

Thus we see so much vandalisation and sabotage of Govt especially DISCOS assets – the gruesome scenes become a routine as the mercury rises in summer.

Having all said, what is the solution?

Mere bashing of govt, DISCOS and other relevant persons- whether individual or legal would create difference? Let us cool our feet and come with realistic answer. It is No

The reply needs much broader and deeper introspection and not surface scratching.

Total crisis of Energy in about 6,000MW. Now we analyze it as under.

Let us visit the globe and look at the pattern of rising from the bed and going to bed- Japan, Korea, China, America, Germany, France- in every developed country, commercial markets close within two hours of sunset. Hardly bars, pharmacies remain open. But we see out markets hum with commercial activities till midnight and even later on in Megapolis of Karachi and Metropolis of Lahore and others.

There exists a conservation potential of 600MW if we close markets within one hour of sunset. Sindh Government under its new pragmatic Chief Minister has taken a decision to close shops at 7 pm and marriage





halls at 10pm but how this decision is implemented is yet to be seen due to cultural inertia. The implementation can become relatively smooth if an alternative is provided to late night shops to switch to solar or energy efficient technologies like LED Lights, 3 Star Labeled fans, Inverter based ACs, Inverters instead of UPS etc., to compensate for their over-consumption or irresponsibility.

Now let's look at the picture from flip side. Walk through markets of Karachi and you will find hardly any shop open before 1:00 pm in the afternoon. While our Holy Book says: WaJa all lailasakanunn: Sura Alinaamayat 96. (And He created night for peace and comfort.)

Late going to bed not only contributes to energy woes but its making people psycho causing coronary diseases and is carcinogenic in nature in addition to disturbing education of children.

Now we see another area. There are more than 1.1 million tube well connection only in Punjab which includes 200,000 on Distribution companies or Electric pumps/motors. Electricians when repair them do not use standard wires of copper, rather use sub-standard wires of aluminum. If they use copper, they use sub-standard gauges. And all of it is mischievously conceived. Electricians think if they uses sub-standard material, motors/pumps will burn earlier forcing farmers visit their shops and pay earlier and frequent. While this is playing havoc with farmers economy, it is wasting national productivity and energy lowering GNP/GDP of the country. Further there are substandard pipes and specifications. Depth of well is more than required resulting into more energy consumed in water pumps. The potential of tube well sector is around 800MW.

Conservation at Homes:

Now we come to conservation at home as "Charity begins at home". We have not trained our successive generations to conserve. Rather conservation is taboo in many sub-cultures and is looked down upon while injunction (command) of Holy Book is: walatusrifu: SuraAhraf Verse 31 (And do not expend more than required).

We see our streetlights on in the broad light. Our air conditions, fan, lights, desktop, laptops remain "ON" due to our attitude of indifference. The situation is frightening in places where electricity bills are to be paid by someone else like educational institutions, offices and hotels.

In fact this is crisis of our attitude- as manufacturers of appliances, as representatives of trade or market associates, as public office holders, as teacher, as parents and as policy makers especially general masses as 90% of hazardous gases are produced from consumer use of petroleum and industry accounts for only 10%.

Israel faces scarcity of water like Pakistan but they start teaching their children from class 3 how to conserve water. We do opposite, Pakistan as one of few countries of the World where clothes are washed in running tap water consuming up to 300 litres instead of bucket which consumes 60 liters, shave is done in running tap water wasting 6 liters instead of mug consuming half liter, cars are washed daily by running pipe water wasting 600 liters instead of air pressure pipes consuming lesser.

All this is despite we are facing acute shortage as per capita availability of water has been reduced to 925





cubic meters viz 5600 cubic meters at time of inception of Pakistan.

This over consumption is not only playing havoc with energy but is a rap with resources of mother earth. It is over stretching capacity of earth and is increasing entropy of universe and is biggest threat to survival of mankind itself.

A recent study sponsored by NASA's Goddard Space Flight Center, after analyzing five risk factors i.e population, climate, water, agriculture and energy, confirms that after few decades "everything we hold dear will come to a collapse " because of "the stretching of resources due to the strain placed on the ecological carrying capacity"

An interesting crisis of attitude is we pay energy bills every month but hardly see the back page where valuable information how to conserve energy is printed. This crisis of attitude is more deeper with affluent and educated ones. We have seen by our experience and research that more educated lot wastes more resources and energy. One reason is their casual attitude due to affordability and second reason is their better access to sophisticated equipment consuming more secondary source of energy e.g. AC's, geysers, desktops, floodlights.

Another flaw in attitude is that affording and affluent lot is not adapting to efficient technology due to casual attitude despite impressive payback periods. For example affluent are not replacing conventional spilt AC's with inverter ones like GREE, Daikin etc, energy savers with LED lights despite threat of cancer, geysers with solar geysers, windows with double glazed windows, UPS with solar inverters and partial shifting of load on renewable technologies like solar and wind. We must acknowledge that each Watt saved, each extra light switched off, will light the hut of another poor man or will give another Rupee to a poor man in shape of employment or opportunity as more than 99% of the energy poor lives in developing world-the largest share is with South Asia. Only in Pakistan, 71.1 Million people live without electricity which is 5% of World's electricity poors. One Megawatt conserved is better than 3 Megawatts generated as it does not produce hazardous emissions and has no further need of capex for laying its wheeling infrastructure.

Now another issue has emerged, that this attitude of us is isolating Pakistan's from its friends as their conscious citizenry is constantly exerting pressure on governments and aid institutions that if Pakistan's public is not helping itself, why the taxpayers money should be spent on Pakistan? They are fully aware of our inefficiencies. Integrated Energy Sector recovery report and plan by friends of democratic Pakistan reads as "Out of the 17 million residential electricity customers in Pakistan, 38% have refrigerators (with a 67% improvement potential), 38% have water pumps (with a 50% improvement potential) and 15% have air conditioning (with a 40% improvement potential)."

The idea is we must transform our attitudes and behaviors. Energy Efficiency Culture needs to be adopted as we are emerging economy and energy consumption of emerging economies is increasing at 3.2% (Pakistan is 3.99%) around the world viz mature economies which are not worried about their energy issue as their growth rate of energy needs is only 1.1%. But they are more concentrating on efficiency and thus we see Germany





getting the highest score on Energy efficiency score board (65) and unfortunately, we, the developing economies are least bothered. Energy Efficiency is "fifth fuel" and the most reliable in a world where cheap oil is ending rapidly either due to depletion of reserves or due to conflicts and natural catastrophes e.g we see Persian Gulf housing 65% of proven oil reserves is suffering from geo-political conflicts in Iraq, Syria, Libya etc and we See Katrina storm disrupted oil and gas production in the Gulf of Mexico. Regarding depletion of reserves, we have already siren call around, as oil production has been falling in 33 of the worlds 48 largest oil producing countries including half of OPEC. Production from existing wells is falling at 5%.

This phenomenon will catalyze poverty as more out of the kitty would be spent on oil and more fertile lands will be diverted towards biofuels leaving lesser area for staple food crops which in turn raise prices of commodities making life difficult for poor and middle income groups. At government level, balance of payments of oil importing countries like Pakistan would be hampered pressurizing exchange rate , making imports costlier and exports cheaper , thus reducing net income of the nations.

Wasting a single Watt of energy is adding harmful gases to the environment right from its production to transmission to distribution and consumption. Fossil fuels are the biggest culprit. These gases called Green House Gases have enveloped the earth and entrap sun light which is converted into heat and thus global average temperature has risen by 0.5 C in one century though there is a threat of increase by 4.5 C by the end of the century. Thus we see sever heat waves in moderate temperature cities like Karachi killing thousands in few days. The level of GHG has increased to 430 ppm from 280 ppm CO2 equivalent. In order to avoid catastrophe, it should be below 450 ppm -550 ppm CO2e. As a result of this crisis of human attitude, we see disasters have increased four times in last 20 years as per world's leading NGO Oxfam. The number of people affected from disasters have risen by 68%, from an average of 174 million a year in 1985-1994 to 254 million a year from 1995-2004. The threat is gigantic as coastal areas will face erosion and high tidal action and sub-merging. Thus fauna and flora, sweet water and agri lands may vanish in these areas. Bangladesh will be affected the most as 70 million people will become homeless.

Who says this wasting attitude is causing five million extra cases of illness a year and more than 150,000 extra deaths . The need of the hour is that each individual should take moral leadership. A radical change is needed in attitudes towards environment. Energy-conservation is not a priority but survival antidote coupled with applying environment friendly energy resources like solar and wind producing 0.1 and 0.02 Kg of CO2 /KWh and cutting off the dangerous resources like Thermal power plant producing above 0.76 Kg of CO2/kWh.





Solar Flight!First Aircraft to Circumnavigate the Globe without a Drop of Liquid Fuel.



The Solar Impulse 2 concluded its journey, becoming the first aircraft to circumnavigate the globe without a drop of liquid fuel. The solar plane's feat does point toward the future of energy. The trip continues for17 months, stopping in 17 cities. Sun power propelled them across approximately 26,718 miles (43,000 kilometers) and finally landed in Abu-Dhabi.

Power Future: Solar Roads for Travel and Power Generation

Solar is popping up just about everywhere, even landfills and parks etc. So why not roads? Indeed, solar road projects are gaining interest around the world, and some promise to even charge electric cars while moving. The Netherlands built the first solar road, a bike path, in 2014. France announced a bolder move in January—over the next five years, it plans to install 1,000 kilometers (621 miles) of solar roads, designed to supply power to five million people.







German company Solmove aims to bring solar panels to German roads on the other hand Idaho-based Solar Roadways has received three rounds of U.S. government funding (plus \$2 million in venture capital) to test its technology. "According to an estimate, Solar panels if used in lieu of existing U.S. roads and walkways could produce more than three times the electricity used in the United States. Besides, panels could charge electric vehicles, first on solar parking lots. With enough solar highways and cars with the right equipment (to pick up energy from induction plates in the road) they might even be able to charge vehicles while moving.

The Cost Challenge

"In theory, solar PV roadways sound great. The issue is cost." According to Mr. Mark Jacobson, an engineering professor at Stanford University, who has promoted a plan for powering the U.S. solely with renewable energy said that "Aside from road dust, particularly black tire dust and diesel exhaust, which will quickly cover a portion of each panel, the continuous traffic covering panels will reduce their solar output" adding they'll likely suffer more wear and tear and need more repairs than other solar panels. He also said that while they don't require land acquisition costs, as do solar power plants, their panels cannot be rotated for optimal solar exposure. He expects a solar road won't be able to compete on cost. Netherlands' solar path is popular as in its first year, 300,000 bikes and mopeds rode the initial 70-meter (230-foot) stretch connecting two Amsterdam suburbs. Officials say the Solar Road produced more energy last year than expected—enough to power three households. It's made of crystalline silicon solar cells, encased in concrete and covered with a translucent layer of tempered glass. In the U.S., Solar Roadways has received more than \$1.5 million from the Department of Transportation over the last six years to develop and test its hexagonal-shaped panels.





Energy policy in sight as battery technology smashes the old order

The US Energy Department is funding 75 projects developing electricity storage. There are plans for hydrogen bromide, or zinc-air batteries, or storage in molten glass, or next-generation flywheels, many claiming "drastic improvements" that can slash storage costs by 80pc to 90pc and reach the magical figure of \$100 per kilowatt hour in relatively short order. The technology is poised to overcome the curse of 'intermittency' that has long bedeviled wind and solar. Surges of excess power will be stored for use later at times when the sun sets, and consumption peaks in the early evening.







Climate and energy policy after Brexit: Impacts on the European Climate and Energy Policy

Brexit will impact on the European Climate and Energy Policy. The EU would lose a market-liberal member who pushed vehemently for an opening of the whole European energy market. Great Britain as well was an important advocate for ambitious climate goals.

This could mean that less aspiring goals by the Central and Eastern European member states could gain in importance. Poland's role especially could become weightier in the EU, due to its current coal-friendly policy. Then again the UK was an opponent of a monitoring of the achievement of the climate and energy goals and in favour of a flexible system regarding the energy mix and energy efficiency which it had in common with Poland and other Central and Eastern European countries. Here there may be stricter control mechanisms enforced as proposed by Germany, Denmark and Sweden.

Should the UK also leave the EU emissions trading system British companies would rapidly sell their certificates. The price for these would decrease as the incentives for climate-friendly investments. The system being almost irrelevant already would finally collapse.

It will be at least two years until the final Brexit. Short-term changes will be the exception. But the UK should be well-positioned not to be isolated from the EU in climate and energy policy. But also the EU should be prepared for the upcoming challenges and should decide if non-members can be part of the Energy Union.







ERC

900 MW of Tidal Power Potential in Costal Area of Pakistan



According to a study conducted by the National Institute of Oceanography, creek network in the Indus deltaic region, extending over 70km along the Arabian Sea, can alone generate 900MW tidal power.

What is Tidal Power?

Tidal energy is produced through the use of tidal energy generators. These large underwater turbines are placed in areas with high tidal movements, and are designed to capture the kinetic motion of the ebbing and surging of ocean tides in order to produce electricity. Tidal power has great potential for future power and electricity generation because of the massive size of the oceans. The tide is created by the gravitational effect of the sun and the moon on the earth causing cyclical movement of the seas. Tidal energy is therefore an entirely predictable form of renewable energy, which can be harnessed in two forms.





Tidal Range

Tidal Range is the vertical difference in height between the high tide and the succeeding low tide.

Artificial tidal barrages or lagoons may be constructed to capture the tide. Turbines in the barrier or lagoon generate electricity as the tide floods into the reservoir; water thus retained can then be released through turbines, again generating electricity once the tide outside the barrier has receded.



Tidal Stream

Tidal Stream is the flow of water as the tide ebbs and floods, and manifests itself as tidal current. Tidal Stream devices seek to extract energy from this kinetic movement of water, much as wind turbines extract energy from the movement of air.

The sea currents created by movement of the tides are often magnified where water is forced to flow through narrow channels or around headlands. There are a number of locations around the coastline of the UK where the tidal stream resource is high, and it is in these areas where early technology developments are taking place to explore the prospect of harnessing tidal energy.





Power Generation projects under China Pakistan Economic Corridor

The Government has allocated over four hundred billion rupees for various power projects in the country under the Annual Development Plan 2016-17. Over five thousand megawatts of electricity will be added to the national grid by the end of next year. Furthermore, energy projects being implemented under China Pakistan Economic Corridor will add over ten thousand megawatts of electricity through coal, hydro and wind power projects by 2018 in the IPP mode. Work on different projects including Neelum-Jhelum, Dasu hydro-power project and Tarbela dam extension project is also in full swing. Thermal projects of four thousand and twenty megawatts in the public sector are also underway. Electricity supply to seven thousand and ninety two villages is also part of Annual Development Plan. It will not only augment electricity supplies in a major way, but also significantly change the energy mix by reducing the average cost of generation.



Source: http://www.cfr.org/pakistan/behind-chinas-gambit-pakistan/p37855





Renewable energy resources to save \$3bln/year

Pakistan can save up to \$3 billion in a year if the country taps into the full potential of alternative energy resources and implements the energy reforms programs, a provincial minister said on Friday. "Pakistan has great energy resources and with strategic planning and implementation to utilise alternative energy sources annual energy savings of up to 25 percent are possible.

Net metering will allow proper functioning for savings and reduction in the load on the grid in addition to conserve existing resources of coal and natural gas. Jahanzeb Khan, additional chief secretary energy said the Punjab accounts for 68 percent of the power consumption in the country and thus regular awareness programs have been conducted under the umbrella of the Punjab Energy Department to give insights to the stakeholders and energy production companies.

An expert said net metering is a win-win for all the distribution companies as they don't have to invest on infrastructure to cater peak load as solar/net metering supplies energy in daytime and peak of load is also in the day hours.

China to build 4,000MW power line from Lahore to Matiari

Pakistani and Chinese officials signed an investment agreement in Beijing on Thursday to build the country's first high-voltage, direct current (HVDC) line, according to a government statement. The line will link the national grid between Matiari and Lahore, some 1,000km apart. The agreement was signed by Water and Power Secretary Mohammad YounusDagha and ShuYinbiao, Chairman of the State Grid Corporation of China. The construction will begin in January and should take about 20 months, a spokesman for the Prime Minister's Office said. The project is the latest in a series of big Chinese investments, most of which fall under planned \$55bn projects for the China-Pakistan Economic Corridor (CPEC).









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