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Adapting to Engineering Education Vision 2020 †

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Abstract: Interdisciplinary energy research has become inevitable in the context of perceived energy break-point after 2050. Power and energy crisis is a matter of life or death for industry and human race on earth. Oil and natural gas peaking alarms started ringing by the start of the 21st century. Available energy reserves are emptying at of thousands of barrels per second and time to discover new energy sources is being wasted to convince and advocate disciplinarians going for interdisciplinary research approach. We will have to invent new ways of supplying 30% of the global energy demand by 2030 and 60% by 2050. It is not possible without putting the emerging bio, nano, and info technologies together in power and energy research laboratories under interdisciplinary and trans-disciplinary approaches. Electrical engineers badly need the supportive hand of energy scientists and technologists to overcome global power, energy, food, and water crises. Engineers and scientists often find it difficult to tolerate each other and usually end up with duplicate resources without any presentable output which requires motivation to develop teamwork spirit to succeed. This paper unveils the potential urgency for an interdisciplinary research approach concerning embedded energy research barriers and solutions in developing countries. Enhancing power and energy multidisciplinary research is a vital general formula that can be tailored to specific regional conditions to minimize the greenhorn blues to run local and global interdisciplinary research programs.

Keywords: trans/multi/interdisciplinary; climate change; global warming; energy crisis

1. Engineering Education Practices

Engineering education practices, in the public sector as well as private universities, in pursuance of their business are seriously violating engineering education ethics in Pakistan. Apprehensively, I am daring to collect my courage in the best interest of the nation to point out some serious flaws and perilous anomalies in ongoing engineering education practices merely to warn the engineering education managers and regulatory bodies, i.e., Pakistan Engineering Council (PEC) and Higher Education Commission (HEC) to take timely actions. Buzz terms have replaced the bona fide hardware based engineering education with simple wordy soft skills instead of the professional skills desired to our engineering industries. Competent engineering education and research regulatory bodies like PEC and HEC need more powers like the ABET in the USA and FEANI in Europe [1] to monitor institutional compliance to engineering education requirements at admission, learning and examining levels in undergraduate degree awarding programs and quality research at postgraduate levels in Pakistan. Engineering education managers have recently realized that their BE telecom, computer, and electronics engineering degrees have no acceptance in the electrical industry as 70% employers want electrical engineers, not telecom, robotic and computer engineers. Two decades ago

the emergence of the Internet and Mobile Telecom Industry created a boom for telecom engineers, but it has now got saturated.

2. A Mandate to Nowhere

Disciplinary education and research systems have failed to keep up with nature due to their narrow spectrum of interests ignoring frontiers of research bridging the major disciplines. This drawback has led to new concepts of multidisciplinary, interdisciplinary and trans-disciplinary research approaches to address the issues. Nature is continuous like the land and sea it is we who have divided it into countries and subcontinents. Disciplinarians usually like to stay isolated, but solutions to many complex problems (like climate change and energy crisis) require the input of multiple disciplines. Establishment of interdisciplinary research centers can foster research on blind corners hidden among significant science and engineering disciplines [2].

3. Interdisciplinary Energy Research

New science and engineering frontiers are neither covered under disciplines nor there exist interdisciplinary programs. The lines distinguishing one speciality area from another is almost indistinguishable. Research student's interests are broader than traditional areas within the disciplines. Students interested in energy in chemistry go for fuel cells, blue energy membrane design and students interested in energy in physics go for solar cells and students in biochemistry go for photosynthesis and biofuels. Significant disciplines usually do not have enough subject specialists to accommodate limited student's interests. Some universities (like University of Minnesota) have started interdisciplinary degree programs to support specific students in their particular research interests in renewable energy, molecular electronics, polymer solar cells, solar paints and photochemistry. Recent oil and gas peaking scenario have severely affected youngster mind and their major interests have focused on energy thrust areas that may include but not limited to long life DC batteries, CO_2 sequestration, carbon capture, super capacitors, anti-greenhouse effect, photosynthesis engineering, fuel cells, fuel cell membranes, osmotic power plants, biofuels, hydrogen storage, and future energy sources. For instance, fiber optic voltage and current sensors, SSR, fuel cells, telemetry, earthquake forecasting, lithospheric architecture and dynamics, quantum wires, dots, single photon lasers and detectors are not covered in any single discipline [3–5]. A straightforward way is to start BS/MS/PhD degree programs by research under the supervision of a committee for each student according to his specific research interests. Trying to force camel and ant to pass through the same pipe is useless where students study subjects merely to earn credits that do not contribute to their research interests. More than 50% of universities do not have trained workforce under any discipline to deal with all above new energy research frontiers. There is no way to go ahead except opting interdisciplinary and transdisciplinary degree programs or research approach to guide students to explore new energy sources in the air, sea and elsewhere [6]. International universities and research institutes have already felt the never-ending complexity of energy issue and started interdisciplinary education and research programs to mitigate energy shortage global insecurity. Universities that have begun interdisciplinary or multidisciplinary energy research programs may include but not limited to Penn State University, Imperial College, Rensselaer, University of Canterbury, and University of Leads etc. According to energy research magazine report, multiple Universities have either started energy education and research programs or are in the phase of multidisciplinary to interdisciplinary transition. Research centers that have started multidisciplinary research include but not limited to the center for energy and the global environment (CEAGE), the Virginia center for coal and energy research (VCCER), the center for energy systems research (CESR), the center for power electronics (CPE), and the macromolecules and interfaces institute (MII) etc.

Future energy supply to society is a big challenge that individual disciplines cannot harness alone without developing a spirit of interdisciplinary research and development. Keeping in view world energy sources and global power needs [4] we must readjust our energy wasting attitudes and prepare our generations to cope with future power and energy crisis. Our forefathers and we have enjoyed the best possible time on earth. We have cars, aero planes and bullet trains to travel but our

dearest children might not have accessed to all these facilities when they grow to our age after 50 years. KSA is considered as the most significant oil player, but she has only 260 Billion barrels reserves (50% from only Ghawar) which at a rate of 3.2 Billion barrels per year (@9 Million barrels per day) can run for 87 years. Canada has 180 Billion barrels reserve but cannot extract more than 3 Million barrels per day (one-third of KSA). Alone US oil consumption is 87 Million barrels per day. To produce 1 Barrel crude oil from tar sands, it produces 2 Tons of dirty sands emitting strange gases to pollute the environment. Public strikes are likely to start at 130$/Barrel oil prices without government subsidies. We must think of reducing reliance on oil not only due to high prices and shortages but also due to global warming of the planet. Fossils fuels combustion triggered greenhouse effect is absolutely responsible for rising temperatures [7]. Power, energy, food, and water shortages are the direct effects but possibilities of floods, cyclones, diseases, dirty environment and extinction of many known organisms may also be the ultimate consequences of increasing the heat on earth's surface [3,4,6–12]. We are cooling our cars and home at expense of heating the planet without imagining the horrible consequences reported by hundreds of the most trusted and reliable researchers. The evil axis of shortages of energy, power and food chains would trigger multiple unexpected events followed by fuel and survival wars reddening the surface of planet earth. Due to food shortages, lawlessness starts that leads to street crimes and insecurity [13]. To defend at own the people have already started catching robbers to burn them alive instead of handing over to police or courts from fear of injustice. It is happening due to high prices and food crisis. Similar blood for oil politics will cause widespread wars. Of course, the global brain has awakened to avert large-scale human bloodshed but professionals who cannot contribute any idea should at least not create problems for others to run renewable energy programs. Many problems can be solved using appropriate engineering tools [14,15], and even if the technology fails at the moment, there is no way out except rethinking again and again. To search more novel techniques, we have to keep an eye on how the inventions take place and how the innovatory works were reported in past.

Energy issue cannot be solved emotionally (individually) instead it needs collective (interdisciplinary) efforts from all branches of science and engineering. Whatsoever, it is the primary headache of the electrical power, chemical, and biochemical engineers how to improve design efficiency for energy conservation, synthesize organic molecules for petroleum like energy and electrons for the DC/AC electricity. All applied science and engineering branches can effectively contribute through interdisciplinary education and research [16]. Chemists and chemical engineers can function better for fuel cells, biochemists and chemical engineers can better perform on bio-fuels, geophysicists, mechanical and electrical engineers can better deliver on ocean power plants, physicists, chemists and electronics engineers can prove better on solar cells, environmentalists, electrical, and mechanical engineers.

4. Conclusions

Scientists and engineers in the developing countries are stuck in the mud of disciplines defense politics which is seriously affecting the interdisciplinary research efforts. Energy avenues are located in frontiers belts among various significant disciplines. Oil and gas peaking scenarios have shaken all communities in East and West except researchers of developing countries who are lagging behind the international community due to their non-technical reasons. Global warming, power, energy, food and water crises are headlines of electronic and print media. Public is frightened of horrible future without energy and food. We are in transition process from oil or gas to new unexplored energy sources. There is no clear new energy source capable of handling current global energy demand after oil and gas. Coal is a potential option, but it would further strengthen the global warming that is already difficult to tolerate. Potential avenues may be located among various major disciplines. Electrical engineers bearing telecom degrees oppose renewable energy research and studies due to their reasons. Developing countries need urgently to move towards interdisciplinary research among universities to make good use of the available manpower to explore new energy sources to join the international race on before we cross the Rubicon defining dead end borders.

References

1. PEC. Pakistan Engineering Council 2018. Available online: http://www.pec.org.pk/ (accessed on 5 September 2018).
2. Heitkemper, M.; McGrath, B.; Killien, M.; Jarrett, M.; Landis, C.; Lentz, M.; Woods, N.; Hayward, K. The role of centers in fostering interdisciplinary research. *Nurs. Outlook* **2008**, *56*, 115–122.e2, doi:10.1016/j.outlook.2008.03.008.
3. Khan, N.; Goldwasser, S.M.; Abas, N.; Kalair, A.R.; Haider, A. Experimental investigation of unidentified helium–neon lasers. *Appl. Opt.* **2017**, *56*, doi:10.1364/AO.56.010030.
4. Abas, N.; Kalair, A.; Khan, N.; Kalair, A.R. Review of GHG emissions in Pakistan compared to SAARC countries. *Renew. Sustain. Energy Rev.* **2017**, *80*, 990–1016, doi:10.1016/j.rser.2017.04.022.
5. Khan, N.; Abas, N.; Kalair, R. Electronic and Photonic Communiqué Bottlenecks Mandate Ultrafast Optics. *Nonlinear Opt. Quantum Opt.* **2017**, *48*, 185–192.
6. Khan, N.; Kalair, A.; Abas, N.; Haider, A. Review of ocean tidal, wave and thermal energy technologies. *Renew. Sustain. Energy Rev.* **2017**, doi:10.1016/j.rser.2017.01.079.
7. Abas, N.; Kalair, A.; Khan, N. Review of fossil fuels and future energy technologies. *Futures* **2015**, *69*, 31–49, doi:10.1016/j.futures.2015.03.003.
8. Abas, N.; Kalair, A.R.; Khan, N.; Haider, A.; Saleem, Z.; Saleem, M.S. Natural and synthetic refrigerants, global warming: A review. *Renew. Sustain. Energy Rev.* **2018**, *90*, doi:10.1016/j.rser.2018.03.099.
9. Kalair, A.; Abas, N.; Khan, N. High repetition rate DFB laser for broadband networks. *Nonlinear Opt. Quantum Opt.* **2018**, *48*, 255–263.
10. Abas, N.; Khan, N.; Haider, A.; Saleem, M.S.; Kalair, A.R. CO_2 Utilization Drivers, Opportunities and Conversion Challenges. *Ref. Modul. Mater. Sci. Mater. Eng.* **2018**, doi:10.1016/B978-0-12-803581-8.10494-1.
11. Khan, N.; Kalair, E.; Abas, N.; Kalair, A.R.; Kalair, A. Energy transition from molecules to atoms and photons. *Eng. Sci. Technol. Int. J.* **2018**, doi:10.1016/j.jestch.2018.05.002.
12. Abas, N.; Khan, N.; Haider, A.; Saleem, M.S. A thermosyphon solar water heating system for sub zero temperature areas. *Cold Reg. Sci. Technol.* **2017**, *143*, 81–92, doi:10.1016/j.coldregions.2017.08.012.
13. Khan, N.; Abas, N. Smart Crime science and Shabby Control Technologies. *VFAST Trans. Educ. Soc. Sci.* **2015**, *6*, 55–71.
14. Khan, N.; Abas, N.; Kalair, A. Design of an Optical Clock Repetition Rate Multiplier. *Nonlinear Opt. Quantum Opt.* **2016**, *48*, 17–28.
15. Khan, N.; Abas, N.; Kalair, A. Multiline distributed feedback dye laser endorses Wien's displacement law. *Appl. Phys.* **2016**, *122*, 93, doi:10.1007/s00340-016-6367-2.
16. Yasmin, M.; Sarkar, M.; Sohail, A. Exploring English Language Needs in the Hotel Industry in Pakistan: An Evaluation of Existing Teaching Material. *J. Hosp. Tour. Educ.* **2016**, *28*, 202–213, doi:10.1080/10963758.2016.1226846.