

# FORTNIGHTLY ENGINEERING REVIEW

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Founded by **Najam ul Hassan (Marhoom)**

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## Economic recovery: Pakistan secures support of Int'l monetary, dev institutions

**G**lobal financial organizations including the World Bank (WB), Asian Development Bank (ADB), and International Finance Corporation (IFC) have assured their support for Pakistan's initiatives aimed at economic stabilization through structural reforms, digital transformation, and privatization efforts.

The assurance came during sidelines meetings of Federal Minister for Finance and Revenue Muhammad Aurangzeb, the leader of a Pakistan delegation in the IMF and World Bank-2024 Spring Meetings in Washington DC, with heads and representatives of the global lending institutions.

Talking to WB Group President Ajay Banga, the finance minister appreciated the bank's continuous support to Pakistan in implementing its development agenda, highlighting the government's commitment to advance significant reforms in taxation, energy, and privatization sectors.

He underscored the importance of digital technologies to enhance governance and public service delivery and asked the gov-



ernment was keen to work closely with the Bank to pursue the revenue reform agenda

as well as timely investment in critical areas to help improve the domestic revenue mobilization. Both sides agreed on the need

for a rolling Country Framework Plan for 10 years.

Ajay Banga assured his full support for Pakistan's reforms and digitalization programs to stabilize the economy. During a meeting with WB Senior Managing Director Axel Van Trotsenburg, Finance Minister Aurangzeb discussed the bank's support and engagement with Pakistan. The meeting explored the option of maximizing Regional IDA resources for development projects in Pakistan including flood-affected areas, agreeing to use the story of effective utilization of Pakistan IDA resources more effectively and benefit from the Knowledge Centre of the bank. The finance minister extended the invitation to the President to visit Pakistan at his earliest convenience.

Muhammad Aurangzeb, in his meeting with President of Asian Development Bank Masatsugu Asakawa, appreciated ABD's partnership with Pakistan to support its development agenda and address its emerging needs. The finance minister highlighted the importance of ongoing projects and future collaboration, emphasizing the important role ADB's support played in

Contd on page 2

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- Christopher Reeve

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# Economic recovery:

*Contd from page 1*  
addressing macroeconomic imbalances, stabilizing the economy, boosting growth, and achieving sustainable development.

ADB President Masatsugu Asakawa reaffirmed the bank's commitment to support and assist Pakistan and expressed keen interest in working together to promote long-term, sustainable development in Pakistan.

In his meeting with Hela Cheikhrouhou, Regional Vice President for MCT, at the International Finance Corporation (IFC), the finance minister briefed her on the government's structural reform agenda focused on taxation, energy and privatization. He appreciated IFC's efforts in enhancing the investment climate in Pakistan, particularly their support in improving national and provincial ease of doing business rankings and meeting universal financial access targets.

Aurangzeb encouraged IFC to scale up its engagement and work with Pakistan in the priority areas of securitization of remittances, mining, airport management and capacity building. Cheikhrouhou expressed her keen interest in furthering IFC's collaborative efforts, emphasizing the importance of tailored financial solutions to sup-

port sustainable development in these sectors. Finance Minister Aurangzeb also met with CEO, U.S. International Development Finance Corporation (DFC) Scott Nathan, highlighting his government's commitment to attract investments across various sectors in Pakistan, including priority areas of agriculture, IT, extractive industry and renewable energy.

He hoped that the DFC would expand its portfolio in Pakistan following the resolution of outstanding issues and tap the significant investment opportunities by leveraging private-sector investments and public-private partnerships. He also requested DFC's assistance in the areas of debt financing, political risk insurance and capacity building to develop and implement potential DFC projects. Nathan appreciated the progress made by Pakistan under the structural reforms agenda leading to macroeconomic stabilization, emphasizing the importance of continuing to build on existing investments, while at the same time pursuing new opportunities.

On the sidelines of the IMF and World Bank-2024 Spring Meetings, finance minister attended the G-24 Finance Ministers and Central Bank Governors' Meet-

ing and held important discussions on sustainable and inclusive economic growth and financial stability. He appreciated the ongoing support provided by the IMF and World Bank to Pakistan to stabilize its economy. The minister highlighted that the government undertook difficult but necessary reforms to move the economy in the right direction. He underscored the need for enhanced private sector engagement, terming it crucial for driving economic growth and innovation. Aurangzeb also highlighted the adverse impact of climate change on developing countries, including Pakistan and stressed importance of leveraging Adaptation Fund to implement effective mitigation and adaptation strategies.

In his meeting with Mohammed Al-Jadaan, Finance Minister of Saudi Arabia, the finance minister expressed gratitude for Kingdom's steadfast financial support to Pakistan in times of economic challenges. Both sides exchanged views on deepening economic and investment relations between the two countries. They also explored new avenues for collaboration to further strengthen trade and investment ties in diverse areas. - APP/ERMD

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# After Haroon, Al Kazim Mansoor in formal run for PEC topslot

By Manzoor Shaikh

The Central Executive Council (CEC), the supreme body of Pakistan Engineers Forum has nominated its President Engr Al Kazim Mansoor as the candidate for Chairman of Pakistan Engineering Council for the upcoming PEC Elections 2024, PEF release and Facebook account said.

It says: It was decided earlier in the meeting that PEF will participate in the PEC Elections 2024 with a strong inclusive panel of honest, dedicated, and professionally competent engineers for the betterment of engineers, the profession, and society.

The CEC entrusted its vote in favor of its President and suggested forming a team of engineers from different walks of life including technology, industry, academia, consulting, and contracting firms.

The forum discussed and reaffirmed its commitment to uplift young and women engineers through the august institution of PEC.

Engr Al Kazim Mansoor, a graduate of NED University, Karachi runs his civil engineering company—The Soilmat Engineers—

and is the second candidate for the top slot in PEC after the formal announcement of his candidacy by Engr. Najeeb Haroon, the sitting chairman of the council.

In the last PEC Elections, held in 2021, the PEF was initially part of the National Engineers Alliance—formed by groups led by Engr. Qadir Shah, Engr. Najeeb Haroon, Engr. Imtiaz Shah, PEF, etc—but parted ways as the forum believed the formula agreed upon in the alliance was violated on the eve of the election.

Following quitting the NEA, PEF whose leader Engr. Imtiaz Shah was NEA candidate for the post of Senior Vice Chairman of the council decided to contest singularly and basketed around 9 thousand votes—the figure stood second country-wide and the first in Punjab. NEA

then led by Engr. Najeeb Haroon picked up Engr. Nayyar Saeed, hailing from Punjab to replace the PEF leader Syed Imtiaz Shah.

The experience from the PEC Election 2021 has likely encouraged PEF to appear as a countable player in the upcoming elections to

be held this year as the forum leaders are believed to be confident to have a strength of 10 thousand voters behind them and with a better strategy they make good gains this time.

Also, they believe the political situation in terms of the standing of political parties and

their support base is pretty different this time. Numerous PEF leaders believe, besides Engr. Najeeb Haroon, Engr. Abdul Qadir Shah is also in the contest for the post of the chairman. In other words, NEA is practically non-existent.

Also, with Engr. Najeeb Haroon's joining of MQM, he does not have the support of Pakistan Tehreek-e-Insaf (PTI) and his opponents see him differently in comparison to PEC Elections 2021. Along with others, PEF might have been eyeing more support in Karachi keeping in view Jamat-e-Islami's rigorous campaigns led by newly elected Amir Hafiz Nameen-ur-Rehman.

But the political situation in Punjab is also different this time. Many engineers believe The Engineers Pakistan (TEP) led by Engr. Jawed Salim Qureshi who believably garnered his support from the PML-N will have to work hard too. No one knows for sure where the PTI support will go in the upcoming council elections. So far, Engr. Waseem Nazir has not formally announced to contest the PEC elections although his comrades claim he would do like Engr. Qureshi's. Yet another name of the aspirant is in rotation—Engr. Ashfaq Shah—the erstwhile ally of Engr. Haroon and Engr. Shah.

In this backdrop, PEF sees itself a player who will be in a comfortable position to be part of the arrangement either led by Engr. Al Kazim Mansoor or any alliance falling fit enough to have considerable gains. In case of latter, PEF's supreme body may again meet to discuss the changed situation. ■



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“Join us in shaping the narrative of sustainability within



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the HVACR sector, as we collectively strive to make a lasting positive impact on the environment and pave the way for a more sustainable tomorrow.” Emphasizing our commitment to excellence, the focus on “Made in Pakistan Production” within the HVACR industry signifies a significant leap toward showcasing the ingenuity, craftsmanship, and technological advancements that our nation has to offer.

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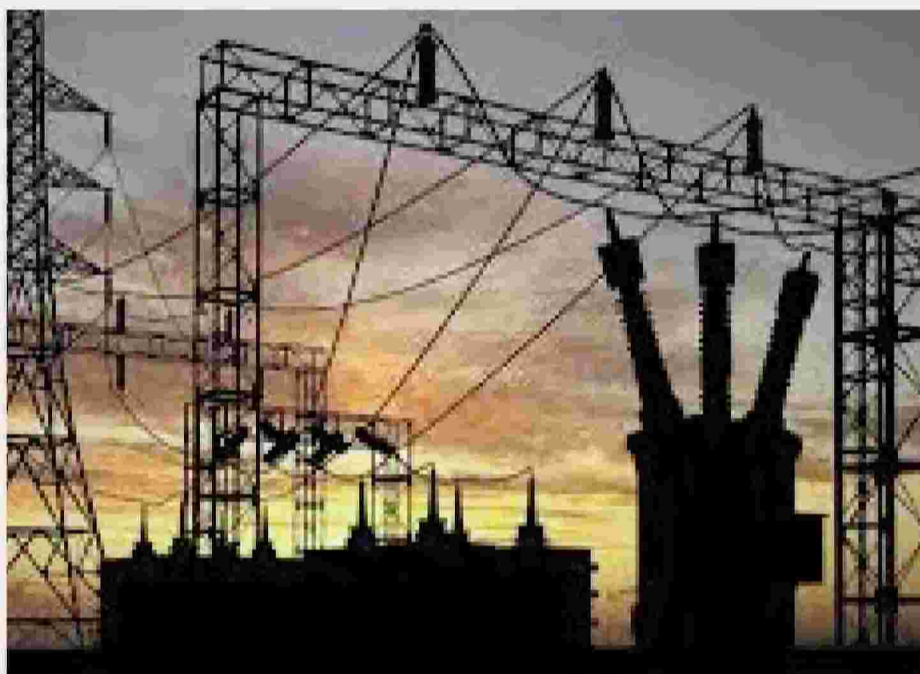
# Rs. 1900 bn from 2500 bn circular debt under recovery!

**M**inister for Power Division Sardar Awais Ahmad Khan Leghari said that on the directives of the Prime Minister, a concrete road map had been chalked out to bring comprehensive reforms in the country's power sec-

tor to control power pilferage, over-billing, and circular debt. He said after assuming charge of the ministry, shortcomings of the power sectors were reviewed to address chronic issues permanently. The government was committed to bringing improvement in the energy sector, he added. He reiterated that no leniency would be given to the power pilferers irrespective of their status and position adding that over-billing would also not be tolerated at any cost. A solid strategy had also been devised to eliminate the menace of power

theft in the country, he said. The minister said the lower-middle class had been suffering from power theft and we had to rectify existing shortcomings in the power system. He went on to say that accumulative loss of power distribution companies (DISCOs) would surge to Rs 560 billion by June. Electricity units worth

CEOs had already been directed to remove 'kunda' before April 23 failing which strict action would be taken against the responsible officials. The minister appreciated the support of the Interior Ministry and FIA for supporting the DISCOs to eliminate power theft. Replying to a question, he said that solar panels having 6800



over Rs 300 billion were consumed by the power pilferers, he added. He said it was the need to an hour to deal with such power pilferers and officials involved in these illegal practices strictly. The country could not afford such misappropriation of billions of rupees to the economy, he added. He vowed not to spare even higher officials such as XENs, SDOs, and Chief Engineers involved in the patronage of power pilferage. He claimed that around 20 percent officials of in the power sector were involved in this dirty practice. Awais said that all

megawatts capacity were imported in the current year adding that most the people were shifting to off grid. In the winter season, an incentive package would have to be introduced to increase power demands to meet capacity payment demand, he added. To another question, the minister said that the circular debt was around Rs 2400 to Rs 2500 billion and out of which Rs 1900 billion was under the head of recovery. To a separate question, he said that tariff adjustment was related to monthly fuel cost adjustment or quarterly cost adjustment mechanism. - APP

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Imagining a Brighter Future for a Sustainable, Resilient Pakistan

# Climate Change Mitigation for a Greener Tomorrow

By Hafsa Ahmed



Climate change has become a complex and pressing issue globally. Antonio Guterres (Secretary General, UN) declared in July 2023.

“The era of global warming has ended. The era of global boiling has arrived.”

Pakistan, the world’s 5th most populous country, although producing less than

1% of carbon footprints, has ranked as the 5th most vulnerable country to climate change in the Global Climate Risk Index. This calls for rapid actions to mitigate climate effects. “It’s time to act now!”

Climate change, driven by fossil fuel emissions, deforestation, and agriculture, is causing global warming. This leads to rising sea levels, melting glaciers, and extreme weather events like floods,

droughts, water scarcity, and forest fires. These impacts are a major threat to Pakistan, demanding rapid response to mitigate climate effects.

The devastating floods of 2022 are repercussions of climate change, that pushed Pakistan two steps back without taking it forward. These catastrophic floods affected 33 million people across the country — of whom an estimated 8m are still exposed to floodwaters or living close to

flooded areas — and displaced 8m people. They caused an estimated Rs3.2 trillion (US\$14.9 billion) of damage — equivalent to 4.8 percent of the GDP for the fiscal year 2022.

This calls for a wake-up call for rapid action to prevent further devastation to the people of Pakistan and its economy due to climate change for a more secure, sustainable, and resilient Pakistan. In this regard, to imag-

inment policies, technological innovations, and human behavior, which includes:

**Accelerating Energy Transition**

Energy is the main contributor to climate change; it accounts for 73% human human-caused greenhouse gases. Pakistan is ranked as 107th in energy transition index (ETI) reported by the World Economic Forum, which reveals that the country has not taken the required ini-

conservation

Energy efficiency and conservation are the key; the right policies can cut emissions by over 40% and help meet climate goals without new technology. Such practices include insulation, heating and cooling system upgrades, adopting building codes, energy-saving appliances and human behavior, etc.

- Water Security and Efficient Water Management

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AI-Powered Climate Change Articles

ine a brighter future for a sustainable, resilient Pakistan and to make it a livable country, a holistic approach is needed to mitigate climate effects based on multifaced strategies encompassing gov-

tiatives about its commitment to energy transition endeavors. Hence, it’s time to accelerate the energy transition i.e. switching from fossil fuel to renewable energy sources. Energy efficiency and

Pakistan, being water water-stressed country caused by climate change and population growth, needs to address growing water scarcity by introducing efficient water management and con-

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# MARI successfully drills another appraisal well in Sindh

**M**ari Petroleum Company Limited (MARI), one of Pakistan's largest energy and exploration companies, has successfully drilled and tested another appraisal well in the Mari Ghazij formation located in Mari Development and Production Lease (D&PL), Sindh.

The company, which is an operator of Mari D&PL with 100 percent working interest, shared the development in a notice to the Pakistan Stock Exchange (PSX) this month.

"MARI has successfully drilled and tested the third appraisal well in the Ghazij formation in the Mari D&PL," read the notice.

"The well was spudded in on February 15, 2024, and drilled down to a depth of 1,483 meters. The post-acid gas flow rate from the well was 10.5 million standard

cubic feet per day (MMSCFD) with a wellhead flowing pressure (WHFP) of

into production in due course after the completion of requisite regulatory formalities.

"We estimate the additional gas flow to have an annualized earnings impact

successfully drilled and tested the appraisal well at Mari Ghazij-I.

Last year in November, the company successfully commenced gas production from its appraisal well Mari Ghazij-I.

By operating the country's largest gas reservoir at Mari Gas Field, Daharki, Sindh, MARI is the second largest producer of natural gas in the country.

The company is an integrated oil and gas exploration and production company and around 70% exploration success rate, which is much higher than industry averages of around 33% national and 14% international.

MARI's key customers include fertilizer manufacturers, power generation companies, gas distribution companies; and refineries. – PR/ERMD



## Climate Change Mitigation for a Greener Tomorrow

ervation practices which include enhancing water storage systems, using efficient irrigation systems, promoting rainwater harvesting, and improving water infrastructure, etc.

- Reforestation
- Preserving and restoring natural ecosystems enhances biodiversity, which can be achieved by establishing green spaces and urban forests within cities that can mitigate heat island effects and enhance air quality.

- Air Pollution Control
- WHO reported that over 99 percent of people breathe unsafe air. Pakistan is ranked as 3rd most air-polluted country. However, air pollution is controllable and preventable by providing universal access to clean energy technologies and practicing sustainable practices in agriculture, transport, household, and industry sectors.

- Sustainable Agriculture & Food Security
- Agricultural sustainability is crucial to mitigate agricultural risks and ensure food security, which can be achieved by promoting climate-resilient practices like crop diversification and conservation agriculture, climate-smart farming techniques, efficient irrigation systems, establishing early warning systems, etc.

- Waste Management and Circular Economy
- Effective waste management involving a reduce, reuse, and recycle strategy can significantly help to mitigate climate effects. In addition, the circular economy is also critical to controlling plastic pollution to tackle the climate crisis.

- Climate Resilient Infrastructure & Sustainable Buildings

ADB reported that 38 percent of global greenhouse gas emissions come from buildings and construction sectors and 35 percent of total energy consumption is also contributed by these sectors. In this regard, sustainable practices including Net Zero Emissions Buildings (NZEB), building insulations, and climate-resilient infrastructure involving retrofitting buildings can help to mitigate climate effects.

- Awareness
- Incorporating climate change education into schools equips students with essential

knowledge. Meanwhile, awareness campaigns through organizing workshops, conferences, and training programs enhance the capabilities of all stakeholders.

- International Cooperation

To tackle shared climate challenges, countries must share best practices and lessons learned. Collaboration on research, technology transfer, and financial support is essential, especially for developing nations. This cooperative approach enables effective solutions and equitable progress in the face of climate change.

- Role of Technological Development & Innovation
- It plays a major role in mitigating the effects of climate change which includes green technologies, sustainable transportation systems (e.g. Electric Vehicle), and efficient technologies in the energy and water sector for conservation. In addition, AI and Big Data Analytics climate models can provide better results to avoid the risk of future weather events with prepared responsive strategies.

In this regard, the government must play a pivotal role in taking sustained actions based on a holistic approach involving multifaceted strategies including; setting ambitious targets to reduce greenhouse gas emissions, regulate emissions, incentivize renewable energy, and invest in research and innovation to achieve climate goals. However, formidable challenges persist such as inadequate international cooperation, reliance on carbon-intensive industries, economic constraints, and policy implementation, etc., which need to be addressed also.

This vision requires commitment, innovation, and collaboration. Policymakers should implement climate-friendly policies, businesses adopt sustainability, educators promote environmental awareness, and individuals embrace eco-friendly living. Together, we can combat climate change and create a sustainable, resilient future for Pakistan to make it a livable country. (Author is a final year student of Electrical Engineering, Mehran University of Engineering & Technology, SZAB Campus, Khairpur Mirs.) ■

490 pounds per square inch (Psi) at 64/64-inch choke size," MARI said.

As per company information, the well shall be put

"The company is also preparing a field development plan for submission to the relevant regulatory authority for approval," it added.

of Rs16.98/share on MARI," said Arif Habib Limited (AHL), a brokerage house, in a note.

Earlier this year, MARI

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# Biomedical Engineering: Bridging Engineering and Medicine

Engr. Dr. Muhammad Nawaz Iqbal

Creating novel answers to challenging healthcare problems is the main objective of the diverse area of biomedical engineering, which acts as a link between engineering and medicine. Fundamentally, biomedical engineering brings engineering concepts and methods to healthcare and medical studies to enable the development of innovative systems and technology that enhance patient outcomes and progress medical knowledge. Medical imaging is one of biomedical engineering's main areas of concentration. Imaging technologies like CT, MRI, and ultrasound are developed and improved by engineers in this sector. With the aid of these technologies, medical personnel can accurately diagnose and visualize medical disorders, gaining crucial insights into the composition and operation of organs and tissues. Improvements in medical imaging help in earlier illness diagnosis and more precise treatment planning.

Medical device design and development heavily relies on the work of biomedical engineers. With their knowledge, these engineers

design technologies that improve quality of life, increase patient mobility, and make it possible for people with disabilities to live more fulfilled lives. Examples of these technologies include wearable health monitoring devices, prosthetics, and arti-



ficial organs. Biomedical engineering's revolutionary effect on patient care is best demonstrated by the confluence of engineering and medicine in the field of medical devices. Biomedical engineers who specialize in tissue engineering strive to produce biological tissues that are functional for use in transplantation or recuperative

medicine. To build scaffolds, materials, and processes that enable tissue growth and development, biological knowledge and engineering principles are combined. Tissue engineering presents enormous promise in mitigating the lack of available

organs, expediting the transplant process, and encouraging the repair of impaired tissues. The field of biomedical engineering encompasses the creation of medications and drug delivery mechanisms. Pharmaceutical scientists and engineers work together to create tailored drug delivery systems that maximize therapeutic efficacy and minimize

adverse effects. The growth of personalized medicine where therapies are customized to each patient's unique characteristics is facilitated by this junction of engineering and medicine.

The use of computational technology and data science

in healthcare is known as biomedical informatics, and it is another important facet of this multidisciplinary area. System administration, analysis, and interpretation tools are created by biomedical informaticians. Biomedical engineering plays a vital role in enhancing decision-making based on data and patient care in the modernization of healthcare through the utilization of medical imaging evaluation algorithms, electronic health records, and healthcare information systems. The work of biomedical engineers relies heavily on developments in molecular biology and genome analysis. This multidisciplinary field's essential components include comprehending the genetic causes of diseases and creating technology for genetic diagnostics. With the help of biomedical engineers, disorders at the molecular level can be better understood through the development of gene treatments, genomic sequencing

technology, and molecular diagnostic tools.

The mechanical features of the human body are the subject of the biomechanics area of biomedical engineering. Biomechanics engineers examine the forces and movements of biological systems, providing valuable insights into fields like sports medicine, orthopedics, and rehabilitation. Prosthetics, orthopedic implants, and rehabilitation equipment are designed with the use of biomechanical models and simulations, which enhance our knowledge of and ability to treat musculoskeletal disorders. Within biomedical engineering, the application of robotics to healthcare is a rapidly developing field. Robotic systems for surgery, rehabilitation, and assistive technology are created by engineers. Robotic exoskeletons help people with mobility disabilities regain movement and independence, while surgical robots improve accuracy and minimize invasiveness in some treatments. In the newly emerging discipline of neuro-engineering, biomedical engineers also make contributions as they investigate the relationship between technology and the nervous system. This covers the advancement of neuro-prosthetics, neural interfaces, and brain-machine interfaces. With the use of these technologies, people suffering from neurological problems may be able to regain their functionality, which could lead to improved movement and communication. Biomedical engineers create tools and technology in the field of cardiovascular engineering to treat circulatory disorders. This covers the advancement of stents, cardiovascular imaging methods, and artificial heart valves. The applica-



tion of biomedical engineering breakthroughs in cardiovascular care improves patient outcomes by aiding in diagnosing, treating, and managing heart-related disorders.

Engineering and medical personnel can work together to tackle global health concerns through the collaboration of biomedical engineering. To make medical procedures more readily available and inexpensive, engineers help build healthcare technology that is appropriate for environments with low resources. The socially significant aspect of biomedical engineering is best illustrated by this dedication to achieving equity in global health. Perched at the nexus of medicine and engineering, biomedical engineering propels innovation to enhance patient outcomes and revolutionize healthcare. To advance medical science and solve difficult healthcare problems, biomedical engineers are essential in a variety of fields, including tissue engineering, medical imaging, device development, informatics, and more. This multidisciplinary area of study is still developing and has the potential to improve healthcare procedures and people's quality of life all around the globe. ■

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## FPCCI waives off 50 pc membership fee for women's chambers

The Federation of Pakistan Chamber of Commerce and Industry (FPCCI) on Thursday announced a waiver of 50 percent membership fee for women's chambers.

President FPCCI Atif Ikram Sheikh in a statement issued here said that the country and society can-

not progress without the full role of women, adding the initiative of reducing membership fees was important

for women's empowerment. "We have fulfilled our promise, for which the full

credit goes to the leadership of United Business Group (UBG), who had promised this during the election campaign," he added.

Ikram said that Pakistani women were extremely talented and the chamber was striving to empower them in the economic field.

"If Pakistan is to progress, we have to make our women educated, skilled, and empowered to business women," he added. ■





BISMILLAH HIR REHMAN NIR RAHEEM

THE STORY OF PROPHET SALEH

By Muhammad Tariq Haq | ESL

The people of Thamud built their houses into the mountains  
 -- God gifted them with great strength and intelligence.

To show them the path of the guidance  
 -- Prophet Saleh was raised amongst them by the most benevolent

He invited people to worship ONE God and seek His repentance  
 -- But, it raised them only in disobedience

Initially they treated Saleh with little resistance  
 -- But his insistence to worship one God, increased it to a great extent

Saleh was asked to present  
 -- A miracle as an evidence

A She Camel; which was a few months pregnant?  
 -- From the rocks of mountains, made it's appearance

Upon her emergence  
 -- Thamuds were cautioned not to commit any nonsense

Sufficient to feed thousands  
 -- She produced milk in abundance

Each one would drink on it's appointed term  
 -- This is how water was between her and the villagers apportioned

Soon this was also not acceptable to the inhabitants  
 -- They decided to kill her without fearing God's annoyance

Her legs were cut off in defiance  
 -- Three days later wrath of God descended upon them as a consequence

Thamuds were so destroyed after this act of ignorance  
 -- Not a trace was left of any existence

Only Saleh and those believed with patience  
 -- Were saved from the sentence

Alsons Group Director Akbar Allana to serve on top BIOMED5.0 committee

Akbar Allana, Director, Alsons Group of Companies has been named as {industry} member for Executive Committee of BIOMED5.0, Patron-in-chief EU CBHE Dr BS Chowdhry said.

BIOMED5.0 project has received funding from the Erasmus+ Capacity Building in the field of Higher Education program under project reference number 101129077. Dr Abdul Qadir Ansari Chairman of the Biomedical Engineering Department MUET is the Coordinator and director of the project. Dr. Inam-ul-Ahad, Lead Coordinator from Dublin City University (DCU) Ireland mentioned that the project Biomed 5.0 is a Capacity Building project in Biomedical Engineering Education for Digital Transformation

and Industry 4.0/5.0 Technologies. He stated that the core objective of this endeavor is to prepare our students for the challenges and opportuni-

(Capacity Building in Higher Education) project Biomed 5.0 further informed that it is 3 3-year project there are 11 consortium partners, which include two universities from Europe and 09 partners from Pakistan. Dublin City University, Ireland, and Technical University of Cluj-Napoca, Romania are the 2 Institutions from Europe in this consortium. This International Consortium of Biomed 5.0 is being led by Mehran University of Engineering and Technology and other partner Institutions from Pakistan including Ziauddin University Karachi, University of Engineering and Technology Taxila, Saleem Habib University Karachi, University of Engineering and Technology Lahore, Sir Syed University of Engineering and Technology Karachi, Liaquat University of Medical and Health Sciences Jamshoro, Balochistan University of Engineering and Technology Khuzdar, and the Pakistan Engineering Council. ■



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# Young Engineers Set to Revolutionize PEC Elections, Engineering Landscape"

By Engr. Syed Shayaan Ali Shah

In a groundbreaking turn of events, the upcoming PEC (Pakistan Engineering Council) elections in August 2024 are expected to witness a seismic shift in leadership. Traditionally dominated by university vice-chancellors and government department heads, this year's elections are poised to be different. A surge in the number of young engineers, comprising 70% of the 400,000+ engineering community in Pakistan, promises to challenge the status quo and inject fresh perspectives into the governing body.

The prevailing old-school approach of the universities' vice-chancellors and government department heads has been criticized for its stagnation and its impact on the quality of engineering education in the country. However, with the emergence of social media and the increasing influence of the younger generation, the dynamics of the PEC elections are set to change. The 2024 elections present an opportunity for the 2 lakh jobless engineers

to play a significant role in reshaping the Council and steering it towards a more progressive and inclusive future.

The infusion of young faces into the Council brings with it a wave of optimism and innovation. With their fresh ideas, technological prowess, and understanding of the challenges faced by their peers, these young engineers are poised to make a lasting impact on the engineering landscape of Pakistan. Their ability to leverage social media platforms will help amplify their voices and mobilize support from their fellow engineers across the country.

One of the pressing issues that the new Council members aim to tackle is the high level of unemployment among engineers. By advocating for policies that bridge the gap between academia and industry, promoting entrepreneurship, and fostering collaboration between the public and private sectors, they hope to create more job opportunities for engi-



neers and ensure their skills are utilized effectively.

The winds of change are blowing across the engineering community in Pakistan as young engineers gear up to challenge the traditional power structures in the upcoming PEC elections. With their determination, fresh perspectives, and utilization of social media, these young leaders are poised to revolutionize the engineering landscape and address the pressing issues faced by their fellow engineers. The stage is set for a new era of leadership that promises to shape a brighter future for engineering in the country.-- ■

# Registered engineers to become professional engineers

## How Pes can benefit from PEC Management Committee Decision

By Engr. Abdul Rehman Shaikh

As per the PEC Act and Bylaws, there are distinct differences between a Registered Engineer (R.E) and a Professional Engineer (P.E) that impact their responsibilities, scope of work, and qualifications.

Registered Engineer vs Professional Engineer

A Registered Engineer (RE) is an engineer who meets the educational requirements and is registered with the PEC. On the other hand, a Professional Engineer (PE) is an engineer who has not only met the educational requirements but also has the necessary experience and has qualified for the Engineering Practice Examination (EPE).

Responsibilities and Scope of Work

- Registered Engineers can perform general engineering duties such as design, supervision, and execution of engineering projects, but only under the guidance of a Professional Engineer.

- Professional Engineers can independently undertake the design, supervision, and execution of engineering projects, as well as provide professional engineering services to the public.

Signing Authority

- Registered Engineers can sign and seal engineering drawings and documents, but only under the supervision of a Professional Engineer.

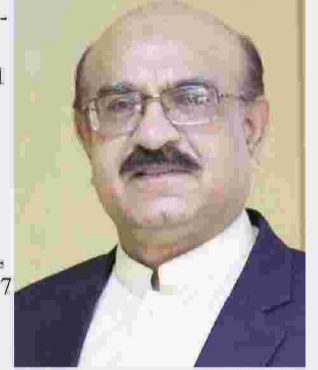
- Professional Engineers can independently sign and seal engineering drawings and documents, taking full responsibility for the work.

Qualifications

- Registered Engineers hold a bachelor's degree in engineering from a PEC-accredited university or institution.

- Professional Engineers hold a bachelor's degree in engineering from a PEC-

accredited university or institution and have a minimum of 5 years of experience after registration as an RE in PEC, with at least 17 Continuing Professional Development (CPD) points, and have qualified the EPE examination.



Professional Title

- Registered Engineers are entitled to use the title "Registered Engineer" or the abbreviation "R.E."

- Professional Engineers are entitled to use the title "Professional Engineer" or the abbreviation "P.E."

PEC Management Committee Decision

The good news for Registered Engineers is that the PEC Management Committee has decided that engineers registered with the PEC before 15th January 2008 are eligible to apply through the PEC website for the title of "Professional Engineer" and are exempt from the EPE requirement. These engineers will only be required to go through an interview process in their relevant field.

This decision by the PEC Management Committee presents an excellent opportunity for Registered Engineers who were registered before the specified date to upgrade their professional status and take advantage of the benefits associated with the Professional Engineer title. By applying for the Professional Engineer designation, these REs can expand their scope of work, sign off on engineering projects independently, and enhance their career prospects. ■

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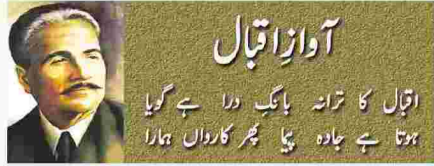
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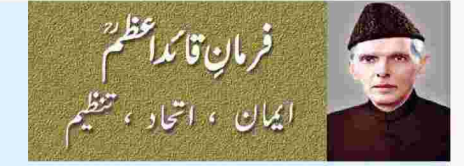
### آوار اقبال

اقبال کا ترانہ پاک در ہے گیا ہوتا ہے جاہ پنا بھر کارواں ہمارا

اے ہمالہ کوئی بازی گاہ ہے تو بھی جسے دست قدرت نے بنایا ہے عناصر کے لئے ہائے کیا فرط طرب میں جھومتا جاتا ہے ابر نکل بے زنجیر کی صورت اڑا جاتا ہے ابر

تیری عمر رفتہ کی اک آن ہے عہد کہن وادیوں میں ہیں تیری کالی گھٹائیں خیمہ زن چوٹیاں تیری ثریا سے ہیں سرگرم سخن تو زمیں پر اور پہنائے فلک تیرا وطن چشمہ دامن ترا آئینہ سیال ہے دامن موج ہوا جس کے لئے رومال ہے ابر کے ہاتھوں میں رھوار ہوا کے واسطے تازیانہ دے دیا برق سر کوہسار نے

کلوئے کلوئے کر رکھے ہیں۔ ہندوستان کے نقشہ پر مسلم ہندوستان اور ہندو ہندوستان پہلے ہی سے موجود ہیں نہ معلوم اس کے متعلق اتنا ویلا کیوں کیا جاتا ہے۔ وہ ملک ہے کہاں جس کے کلوئے کلوئے کیے جائیں گے؟ اور وہ قوم کہاں ہے جس کی قومیت فنا کی جانے کو ہے؟ وہ طاقت جس کے قبضہ قدرت میں آج ہندوستان ہے وہ انگریزوں کی طاقت ہے اور یہ جو ایک خیال دماغوں میں بیٹھ گیا ہے کہ ہندوستان ایک متحدہ ملک ہے اور اس کی اپنی حکومت ہے وہ صرف اس وجہ سے ہے کہ انگریز اس سارے ملک پر حکمران ہیں۔ (مسلم لیگ کانفرنس، بمبئی، 26 مئی 1940ء)



### فرمان قائد اعظم

ایمان، اتحاد، تنظیم

#### اصول اور تفصیلات

گاندھی جی کہتے ہیں "ہندوستان کو جیتنے کی کلوئے کلوئے کیا جا رہا ہے۔" دلچسپ اور پوری بات ہے "بچے کے کلوئے کے ہاں ہے۔" قدرت نے پہلے ہی سے ہندوستان کو تقسیم کر رکھا ہے اور اس کے

## پاکستان سائنس و ٹیکنالوجی کے میدان میں پیچھے کیوں؟

ای ڈی جی جیسی جامعات اور انجینئرنگ تعلیم اداروں کی گرانٹ میں اضافہ کرے جہاں آج بھی اکثر لیب میں کئی برس پرانے آلات پڑے ہیں جو آج کی دنیا سے کسی طور مطابقت نہیں رکھتے۔ جب طلبہ عملی میدان میں قدم رکھتے ہیں تو انہیں وہاں ایک الگ ہی دنیا ملتی ہے انہیں ایک مرتبہ پھر تعلیمی سفر شروع کرنا پڑتا ہے۔ امریکہ اور برطانیہ یا چین ہمیشہ سے ترقی یافتہ اور ٹیکنالوجی کے ماہر نہیں تھے بلکہ انہوں نے اپنی صنعت کو فروغ دے کر ترقی کی۔ اور صنعت کے فروغ کے لئے ٹیکنالوجی کے فروغ پر سرمایہ کاری کی۔ حکومت پاکستان اگر 60 کی دہائی تک اپنے ہی ملک کی ترقی پر ریسرچ کر لے تو کافی زیادہ مثبت نتائج مل سکتے ہیں۔ رپورٹس کے مطابق پاکستان میں آئی ٹی ماہرین مطلوبہ تعداد اور خاص کر مطلوبہ اہلیت کے مطابق نہیں ملتے۔ حکومت غیر ضروری اخراجات کم کر کے ٹیکنالوجی کے فروغ پر لگائے اور ساتھ ساتھ کوالٹی سٹینڈرڈ پر ترقی یافتہ ممالک میں جدید تعلیم کے لئے اس شرط پر بھیجے کہ وہ پاکستان واپس آکر یہاں کے بچوں کو تعلیم دینگے تو اس سے قابل اور ہنرمند افراد تیار ہو سکتے ہیں۔

پاکستان میں سائنس و ٹیکنالوجی کے شعبے میں تحقیق کے لیے مواقعوں کی کمی ہمیشہ سے ایک مسئلہ رہا ہے۔ 2023ء میں پاکستان اور امریکہ نے سائنس اور ٹیکنالوجی میں باہمی تعاون کے ایک معاہدے کو مزید پانچ سال کے لیے توسیع دی تاہم اس معاہدے پر بھی سوالات کھڑے کر دیئے گئے تھے۔ ہائر ایجوکیشن کمیشن (ایچ ای سی) کی ویب سائٹ کے مطابق پاکستان اور امریکہ نے 2003ء میں اس تعاون کے حوالے سے فریم ورک تیار کیا تھا جبکہ اس پروگرام میں تعاون کا سلسلہ 2005ء میں شروع ہو چکا تھا جب یونائیٹڈ اسٹیٹس انجینیئرنگ فار انٹرنیشنل ڈیولپمنٹ یا یو ایس آئی ڈی نے پاکستانی وزارت سائنس و ٹیکنالوجی اور ایچ ای سی کے ساتھ مل کر اس پروگرام پر کام شروع کیا۔ کئی سائنسی ماہرین کے خیال میں اس معاہدے سے پاکستان کا فائدہ ہے۔ تاہم سوال یہ پیدا ہوتا ہے کہ امریکی فنڈنگ کے باوجود پاکستان میں سائنسی ترقی کی رفتار انتہائی سست کیوں ہے؟ اس کی مختلف وجوہات میں اہم ترین بدعنوانی، ناقص انتظامیہ، ریسرچ کے کام میں چر بہ سازی کا رجحان اور سیاسی اثر رسوخ سائنس اور ٹیکنالوجی کی ترقی کی راہ میں رکاوٹ ہیں۔ ڈی ڈی کی ایک رپورٹ کے مطابق مثال کے طور پر 20 سال سے زائد کے عرصے میں ایچ ای سی اور دوسرے اداروں کی طرف سے دوائیوں اور ویکسین پر تحقیق کرنے والے صرف ایک ہی ادارے کو 40 ارب روپے دیئے گئے، جس نے نانو کوئی ویکسین تیار کی اور نہ ہی کوئی دوائی۔ ملک میں ڈھائی سو سے زیادہ یونیورسٹیاں ہیں لیکن ان میں نصف سے زائد یعنی ڈیڑھ سو کا معیار انتہائی پست ہے۔ پاکستان میں ہارڈ ویئر ریسرچ بہت کم ہے۔ اور جو تھوڑی بہت ریسرچ ہوتی ہے وہ اپنے معاملات کو کسی نہ کسی طرح حل کرنے کے لیے کی جاتی ہے۔

پاکستان آئی ٹی انڈسٹری سے وابستہ محقق کا شرف حسین نے اپنے تحقیقی مضمون 'Priorities Sector Tech Pakistan Adjusting' میں لکھا کہ "مجموعی اعتبار سے تیس فیصد کی شرح نمو کے ساتھ پاکستان کے آئی ٹی شعبے نے گزشتہ پانچ برس کے دوران 178 فیصد ترقی کی جو انتہائی غیر معمولی ہے۔ شرح نمو کے اعتبار سے اس نے ٹیکنالوجی سمیت دیگر تمام مقامی صنعتوں کو پیچھے چھوڑ دیا ہے۔ سرکاری ادارے پاکستان ٹیک ڈیولپمنٹ کی 'پاکستان آئی ٹی انڈسٹری کا اجمالی جائزہ' کے نام سے شائع ہونے والی رپورٹ کے مطابق "پاکستان کی آئی ٹی برآمدات 655 ملین ڈالر تھیں جو پانچ برس کے دوران 2.1 بلین ڈالر کی متاثر کن حد تک پہنچ گئیں۔ اس دوران ملک میں رجسٹرڈ آئی ٹی کمپنیوں کی تعداد تین سو پچانوے سے بڑھ کر دو ہزار آٹھ سو چھپیس ہو گئی۔ رپورٹ کے مطابق "پاکستان 2025 تک آئی ٹی کے شعبے کو ایک ٹریلین ڈالر تک پہنچانا چاہتا ہے اور اگر 15 فیصد کی شرح نمو کے ساتھ یہ سفر جاری رہا تو ہدف آسانی حاصل کیا جاسکے گا۔"

پاکستان کوئی نہ کسی طرح حل کرنے کے لیے کی جاتی ہے۔ خیال کیا جاتا ہے کہ پاکستان میں سائنس اور ٹیکنالوجی کی ترویج کے لیے رقم بھی بہت کم مختص کی جاتی ہے۔ مثال کے طور پر مالی سال 2023 اور 24 میں سوشل سیکلر ڈیولپمنٹ پروگرام میں وزارت سائنس اور ٹیکنالوجی کے لیے جو ترقیاتی پروگرام رکھے گئے ان کی مالیت صرف آٹھ ہزار ملین روپے ہے۔ پاکستان میں سائنس کے حوالے سے کوئی انتہائی مستند ڈیٹا بھی موجود نہیں ہے۔ پاکستان کونسل فار سائنس اینڈ ٹیکنالوجی کی طرف سے سائنس اینڈ ٹیکنالوجی کے شعبے کے اعداد و شمار سے متعلق آخری ڈیٹا بک 2009 میں شائع کی گئی، جبکہ اس سے پہلے صرف ایک اور ڈیٹا بک شائع کی گئی تھی۔ پاکستان کے نجی شعبے میں سائنس اور ٹیکنالوجی کے میدان میں تحقیق کے لیے ریسرچ کا کوئی ادارہ نہیں جبکہ سرکاری شعبے میں سائنسی تحقیق اور ترقی کے پچاسی ادارے قائم ہیں۔ سائنس اور ٹیکنالوجی کی ترقی کسی بھی ملک و قوم کی ترقی کی ضامن ہے۔ سائنس اور انجینئرنگ کے شعبے جات کو ایک دوسرے سے مربوط کر کے دونوں شعبوں میں نہ صرف جدید تحقیق ممکن ہو سکتی ہے بلکہ اس تحقیق کے نتیجے میں صحت، تعلیم، زراعت حتیٰ کہ مقررہ کو بھی ترقی دی جاسکتی ہے۔ ٹیکنالوجی کا استعمال معاشی ترقی، طبی دیکھ بھال، قومی سلامتی، ماحولیاتی تبدیلیوں کی جانچ سمیت دیگر اہم شعبوں میں بہتری لاسکتا ہے۔ معاشی ترقی کے لیے انجینئرنگ کا کردار بہت اہم ہے۔ اگر کسی ملک میں انجینئرنگ کی تعلیم کو فروغ نہ دیا جائے تو وہ معاشی حالات میں بہتری نہیں لاسکتا۔ گزشتہ سال حکومت نے بجٹ میں تعلیم کے لیے 82 ارب روپے مختص کیے جس میں اعلیٰ تعلیم کا بجٹ بھی شامل ہے۔ سوال یہ ہوتا ہے ہی آئی ایس پی جیسے پروگرام روزگار کے مواقع پیدا کرنے اور ہنرمند بنانے پر خرچ کیوں نہیں کئے جاتے؟ ہم کیوں اپنی قوم کو بھکاری بنا رہے ہیں۔

معیشت میں اس کا بڑھتا ہوا کردار حوصلہ افزا پیش رفت ہے۔ عالمی سطح پر پاکستانی آئی ٹی ایکسپلرٹس کی صلاحیتوں کے اعتراف کی ایک جھلک ہانگ کانگ میں منعقد ہونے والی ایشیا پیسیفک انفارمیشن اینڈ کمیونیکیشن ایوارڈز میں دیکھی جاسکتی ہے جہاں گزشتہ برس کی کارکردگی پر پاکستان کی آئی ٹی کمپنیوں نے آٹھ بڑے ایوارڈ اپنے نام کیے، ان میں ایک گولڈ اور 7 میرٹ ایوارڈ شامل ہیں۔ جبکہ ورلڈ بینک کی رپورٹ کے مطابق "پاکستان کے فری لانسرز کا 42 فیصد حصہ سافٹ ویئر ڈیولپمنٹ سے جڑا ہے اور یہ سافٹ ویئر ڈیولپمنٹ سے وابستہ فری لانسرز کی عالمی تعداد کا 10.5 فیصد بنتا ہے۔ جو بگ بگ ویش، سری لنکا اور جنوبی ایشیا کے کئی دیگر ممالک سے زیادہ ہے۔ رپورٹ کے مطابق "پاکستان 2025 تک آئی ٹی کے شعبے کو ایک ٹریلین ڈالر تک پہنچانا چاہتا ہے اور اگر 15 فیصد کی شرح نمو کے ساتھ یہ سفر جاری رہا تو ہدف آسانی حاصل کیا جاسکے گا۔"

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## عالمی بینک داسو ہائیڈرو پاور منصوبے کیلئے ایک ارب ڈالر قرض دیگا

قرض کی منظوری جون میں، ذرائع، لاگت 13 فیصد اضافے سے بڑھ کر 4.9 ارب ڈالر ہوگی، 2160 میگا واٹ بجلی حاصل کی جاسکے گی، سالانہ 1.8 ارب ڈالر کی بچت ہوگی، عالمی بینک

عالمی بینک 2,160 میگا واٹ کے داسو ہائیڈرو پاور پراجیکٹ کیلئے ایک ارب ڈالر کا قرض فراہم کرے گا، اس مہنگے پراجیکٹ کی تعمیر پاکستان میں سستی بجلی کی فراہمی کیلئے انتہائی ضروری ہے، حکومتی ذرائع کا کہنا ہے کہ عالمی بینک کا پور ڈ آف دستاویزات میں کہا گیا ہے کہ وہ ری کنسٹرکشن اینڈ ڈیولپمنٹ کیلئے اپنے انٹرنیشنل بینک اور انٹرنیشنل ڈیولپمنٹ ایسوسی ایشن کے ذریعے مزید ایک ارب ڈالر فراہم کرے گا، یہ عالمی بینک کی جانب سے تیسری بڑی قرض ہے، قبل ازیں عالمی بینک انتہائی کاموں کیلئے ایندھن سے بننے والی بجلی انتہائی مہنگی پڑتی ہے، جس کی وجہ سے پاکستان کو شدید بحران کا سامنا ہے، اور گھریلو صارفین سمیت فیکٹریز، مساجد اور اسپتال وغیرہ نے انٹرنیشنل گریڈ سے جان چھڑا کر سولر سسٹم لگانا شروع کر دیا ہے، جس سے باقی بچ رہنے والے صارفین پر بوجھ مزید بڑھ جائے گا۔ عالمی بینک کے نئے تخمینے کے مطابق منصوبے کی لاگت 13 فیصد اضافے کے ساتھ 4.3 ارب ڈالر سے بڑھ کر 4.9 ارب ڈالر ہوگی ہے، اس منصوبے کو مکمل کرنے کا پہلا ہدف دسمبر 2021 مقرر کیا گیا تھا، نواز شریف حکومت نے 2013 میں دیا میر بھاشا ڈیم پراجیکٹ کو ترجیح دی تھی، اور وہ 2018 سے پہلے اس کے پہلے مرحلے کا افتتاح کرنے کے خواہش مند تھے، لیکن منصوبہ تعطل کا شکار ہوتا گیا، تاہم اب عالمی بینک نے اس کی تکمیل کی مدت 2028

مقرر کی ہے۔ عالمی بینک کا کہنا ہے کہ اس منصوبے کے ذریعے پاکستان کو درآمدی ایندھن کی مد میں سالانہ 1.8 ارب ڈالر کی بچت ہوگی، کاربن ڈائی آکسائیڈ کے اخراج میں 5 ملین ٹن کمی ہوگی۔

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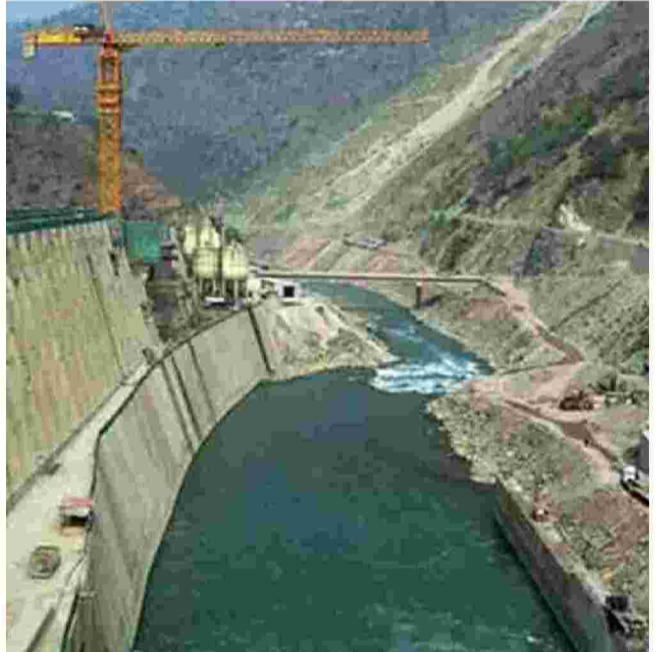
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## ریکوڈک منصوبے کی راہ میں رکاوٹیں دور کریں گے، وزیر اعظم

ریکوڈک پر کام کر رہے ہیں، بندرگاہ تک لاجسٹکس، آمدورفت کی سیکورٹی یقینی بنائیں گے، روڈ نیٹ ورک اپ گریڈ کریں گے، سرکاری سطح پر اسٹیک ہولڈرز سے مشاورت ہوگی

وزیر اعظم شہباز شریف نے ہدایت کی ہے کہ ریکوڈک منصوبے کے حوالے سے سرکاری سطح پر تمام اسٹیک ہولڈرز سے مشاورت کی جائے اور اس میں جہاں جہاں رکاوٹیں ہوں انہیں دور کیا جائے، بلوچستان میں معدنیات سے بھرپور فائدہ اٹھانے کیلئے مواصلات کے انفراسٹرکچر کے حوالے سے منصوبہ سازی کی جائے گی، وزیر اعظم نے ریکوڈک روڈ اور ریل کنکٹیوٹیٹی پر بریفنگ طلب کر لی۔ وزیر اعظم کی زیر صدارت ریکوڈک منصوبے کے حوالے سے اہم اجلاس لاہور میں ہوا۔ اجلاس میں سیکرٹری جنرل کے وفد نے چیف ایگزیکٹو آفیسر مارک برسٹو کی سربراہی میں بڈ ریکوڈک پبلک سٹریٹجی شہباز شریف نے کہا ریکوڈک منصوبے پر کام کرنے والوں کی اور ریکوڈک سے بندرگاہ تک لاجسٹکس اور آمدورفت کے حوالے سے سیکورٹی یقینی بنائی جائے گی۔ منصوبے کے حوالے سے سرکاری سطح پر تمام اسٹیک ہولڈرز سے مشاورت کی جائے گی اور جہاں جہاں

رکاوٹیں ہیں وہ دور کی جائیں گی۔ بلوچستان میں معدنیات سے بھرپور فائدہ اٹھانے کیلئے مواصلات کے انفراسٹرکچر، خصوصاً ریلوے لائن کے حوالے سے منصوبہ سازی کی جائے گی۔ انہوں نے ہدایت کی کہ ریکوڈک منصوبے کو بڈ ریکوڈک گوارڈ سے جوڑنے کیلئے موجودہ روڈ نیٹ ورک کی اپ گریڈیشن کا کام جلد از جلد کیا جائے۔ جہاں جہاں نئی سڑکیں تعمیر ہو رہی ہیں ان کی تیل کا کام تیز کر دیا جائے۔ نئی ریلوے لائن سے معدنیات سے بھرپور ضلع چاغی مستفید ہو سکے گا اور کان کنی کی صنعت کو فروغ ملے گا۔ وزیر اعظم نے ریکوڈک منصوبے کے حوالے سے انوائٹمنٹ اینڈ سوشل ای پی سی اسٹیمٹ کو جلد از جلد مکمل کرنے کے لیے سرکاری سطح پر تمام تر رکاوٹیں دور کرنے کی بھی ہدایت کی۔ ایک ٹویٹ میں شہباز شریف نے کہا پاکستان اور سعودی عرب ہر محاذ پر ایک دوسرے کے شانہ بشانہ کھڑے رہیں گے۔



## 'Surprising' hidden activity of semiconductor material spotted by researchers

**N**ew research suggests that materials commonly overlooked in computer chip design actually play an important role in information processing, a discovery which could lead to faster and more efficient electronics.

Using advanced imaging techniques, an international team led by Penn State researchers found that the material that a semiconductor chip device is built on, called the substrate, responds to changes in electricity much like the semiconductor on top of it.

The researchers worked with the semiconductor material, vanadium dioxide, which they said shows great potential as an electronic switch. They also studied how vanadium dioxide interacts with the substrate material titanium dioxide and said they were surprised to discover that there seems to be an active layer in the substrate that behaves similarly to the semiconductor material on top of it when the semiconductor switches between an insulator -- not letting electricity flow -- and a metal -- letting electricity flow. The revelation that substrates can play an active role in semiconductor processes is significant for designing future materials and devices, said study lead Venkatraman Gopalan, professor of materials science and engineering and of physics at Penn State.

"New ideas are needed for smaller and faster electronics in order to keep up with Moore's law," said Gopalan, the corresponding author of the study in *Advanced Materials*. "One idea being pursued is materials, such as vanadium dioxide, that can switch between metal -- the one state -- and insulator -- the zero state -- states in a trillionth of a second. This is known as undergoing metal-insulator transitions."

The potential of vanadium dioxide as a metal-to-insulator transistor is well-documented and the material is considered promising for semiconductor technology due to its low energy consumption, Gopalan said. However, the material's properties are still not fully understood, and until now, it has usually been observed in isolation rather than while functioning in a real device.

Vanadium dioxide has strongly correlated electronic effects, meaning the repulsion between electrons interferes with the device, so cannot be ignored as is currently done in silicon-based electronics. This characteristic can result in materials with novel functionalities such as high-temperature superconductivity and enhanced magnetic properties.

"The underlying physics of this material is less understood, and its performance in a device geometry is even lesser understood," Gopalan said. "If we can make them work, there will be a renaissance in electronics. In particular, neuromorphic computing -- where computer systems that take inspiration from the brains of living systems with neurons --

and back, when the electrical pulses arrive," Gopalan said. "This is like watching the tail wagging the dog, which stumped us for a long while. This surprising and previously overlooked observation completely changes how we need to view this technology."

To understand these findings, the theory and simulation effort -- led by Long-Qing

and the lead theory author, the researchers disentangled the material's responses and observed them individually using phase field simulations, a simulation that helps scientists understand material changes over time by depicting various states of matter in a virtual setting.

"By bringing these experts together and pooling our understanding of the problem, we were able to go far beyond our individual scope of expertise and discover something new," said Roman Engel-Herbert, director of the Paul Drude Institute of Solid State Electronics in Berlin, Germany, and co-author of the study whose group grew these films along with Darrell Schlom's group at Cornell University. "Recognizing the potential of functional materials necessitates an appreciation of their broader context, just as complex scientific challenges can only be solved through widening our individual perspectives."

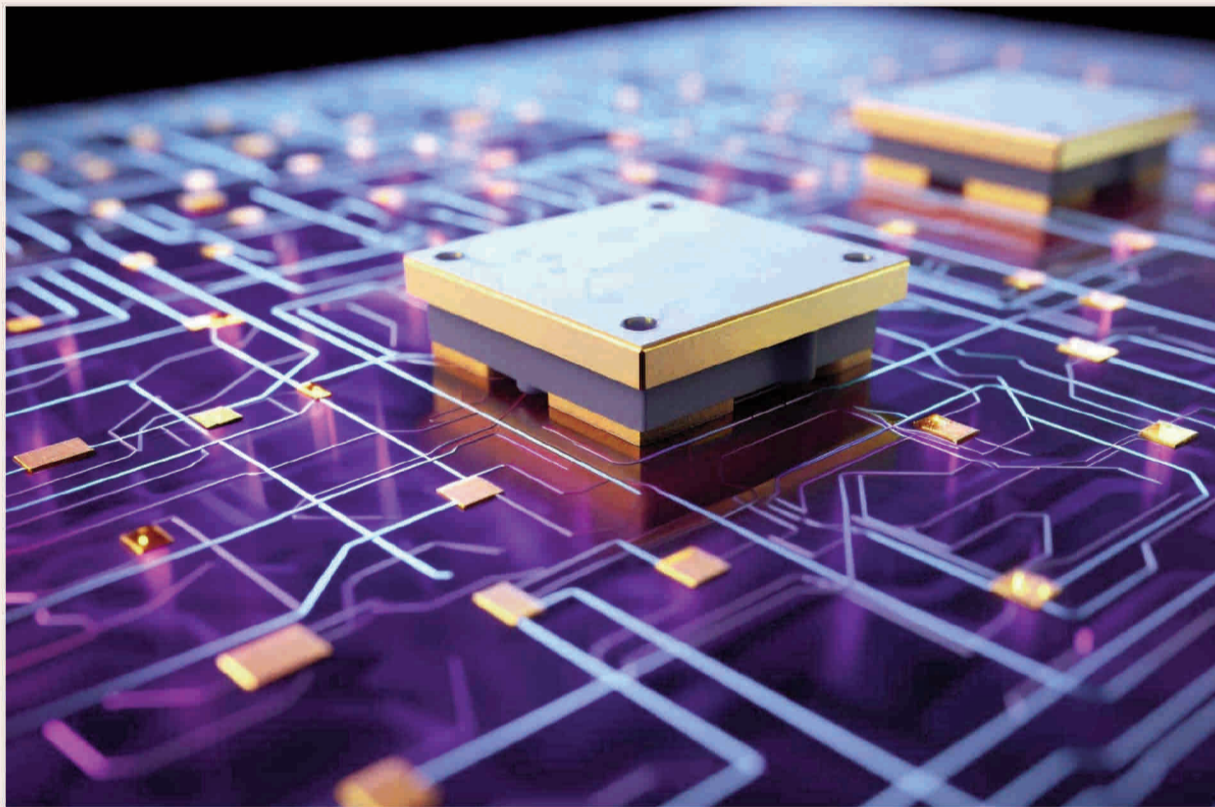
The collaboration enabled both a significant amount of progress to happen in a short period of time and work to be done in a shorter period of time, and brought in a variety of perspectives from multiple disciplines.

The responses themselves require further investigation, researchers said, but they believe

that understanding them will assist in identifying previously unknown capabilities of vanadium dioxide, including potential yet-to-be discovered phenomena in the TiO<sub>2</sub> substrate that was considered passive before this study. The study itself unfolded over 10 years, Gopalan noted, including validating the results.

"This is what it takes to go from interesting science to a working device you can hold in the palm of your hand," Gopalan said. "Experiments and theory are complex and require large-scale collaborative teams working closely together over an extended period of time to solve difficult problems that could have a large impact. We hope and expect that this will accelerate the progress towards a new generation of electronic devices."

Prior to his current position, Stone completed a postdoctoral fellowship at Penn State. Along with Gopalan, Engel-Herbert, Chen, Schlom, Stone and Chi, other authors of the paper include Matthew Jerry, graduate student, and Vladimir Stoica, research associate professor, both from Penn State; Hanjong Paik from Cornell University; Zhonghou Cai and Haidan Wen from Argonne National Laboratory, and Suman Datta from the Georgia Institute of Technology. The Department of Energy primarily supported this work. The U.S. National Science Foundation supported the film growth for this study. -- SD



could seriously benefit by using such devices."

The team investigated vanadium dioxide in a device rather than in isolation, applying a voltage to it to make it switch from an insulating to a conducting state. They used the Advanced Photon Source (APS) at Argonne National Laboratory, which uses powerful X-ray beams to study the behavior and structure of materials on the atomic level. When mapping the spatial and temporal response of the material to the switching event, the researchers observed unexpected changes to the structure of the material and substrate.

"What we found was that as the vanadium dioxide film changes to a metal, the whole film channel bulges, which is very surprising," Gopalan said. "Normally it is supposed to shrink. So clearly something else was going on in the film geometry that was missed before."

The APS X-ray penetrated through the vanadium dioxide film and into the titanium dioxide (TiO<sub>2</sub>) substrate -- which is normally considered an electrically and mechanically passive material -- that the thin film was grown on.

"We found to our great surprise that this substrate is very much active, jiving and responding in completely surprising ways as the film switches from an insulator to a metal

Chen, Hamer Professor of Materials Science and Engineering, professor of engineering science and mechanics and of mathematics at Penn State -- developed a theoretical framework to explain the entire process of the film and the substrate bulging instead of shrinking. When their model incorporated naturally occurring missing oxygen atoms in this material of two types, charged and uncharged, the experimental results could be satisfactorily explained.

"These neutral oxygen vacancies hold a charge of two electrons, which they can release when the material switches from an insulator to a metal," Gopalan said. "The oxygen vacancy left behind is now charged and swells up, leading to the observed surprising swelling in the device. This can also happen in the substrate. All of these physical processes are beautifully captured in the phase-field theory and modelling performed in this work for the first time by the postdoc Yin Shi in Professor Chen's group."

Gopalan credited the multidisciplinary team's combined expertise in material growth, synthesis, structure analysis and synchrotron beamline operation with the new understanding. Using a collaborative approach led by Greg Stone, a physical scientist with the U.S. Army and the lead experimental author, and Yin Chi, postdoctoral scholar at Penn State

# Breakthrough for next-generation digital displays



Researchers at Linköping University, Sweden, have developed a digital display screen where the LEDs themselves react to touch, light, fingerprints and the user's pulse, among other things. Their results, published in *Nature Electronics*, could be the start of a whole new generation of displays for phones, computers and tablets.

"We've now shown that our design principle works.

Our results show that there is great potential for a new generation of digital displays where new advanced features can be created. From now on, it's about improving the technology into a commercially viable product," says Feng Gao, professor in optoelectronics at Linköping University (LiU).

Digital displays have become a cornerstone of almost all personal electronics. However, the most modern LCD and OLED screens on the market can only display information.

To become a multi-func-

tion display that detects touch, fingerprints or changing lighting conditions, a variety of sensors are required that are layered on top of or around the display.

Researchers at Linköping University have now developed a completely new type of display where all sensor functions are also found in the display's LEDs without the need of any additional sensors.

The LEDs are made of a crystalline material called perovskite.

Its excellent ability of light absorption and emission is the key that enables the

newly developed screen.

In addition to the screen reacting to touch, light, fingerprints and the user's pulse, the device can also be charged through the screen thanks to the perovskites' ability to also act as solar cells.

"Here's an example -- your smartwatch screen is off most of the time. During the off-time of the screen, instead of displaying information, it can harvest light to charge your watch, significantly extending how long you can go between charges," says Chunxiang Bao, associate professor at

Nanjing University, previously a postdoc researcher at LiU and the lead author of the paper.

For a screen to display all colours, there needs to be LEDs in three colours -- red, green and blue -- that glow with different intensity and thus produce thousands of different colours.

The researchers at Linköping University have developed screens with perovskite LEDs in all three colours, paving the way for a screen that can display all colours within the visible light spectrum.

But there are still many challenges to be solved before the screen is in everyone's pocket.

Zhongcheng Yuan, researcher at the University of Oxford, previously postdoc at LiU and the other lead author of the paper, believes that many of the problems will be solved within ten years:

"For instance, the service life of perovskite LEDs needs to be improved. At present, the screen only works for a few hours before the material becomes unstable, and the LEDs go out," he says. — SD

## Neutrons rule the roost for cage-free lithium ions

An international team of scientists found a way to improve battery design that could produce safer, more powerful lithium batteries.

The team used quasi-elastic neutron scattering at Oak Ridge National Laboratory to set the first benchmark, one-nanosecond, or one billionth of a second, for a mixture of lithium salt and an organic polymer electrolyte.

"It all comes down to the study of materials," said Eugene Mamontov, ORNL Chemical Spectroscopy group leader.

"And polymer electrolytes won't catch fire the way liquid electrolytes do in lithium batteries."

The team used the neutron technique to validate computer simulations, ending a long-standing debate about how long it takes lithium ions to break free from tiny

cages created by polymer electrolytes.

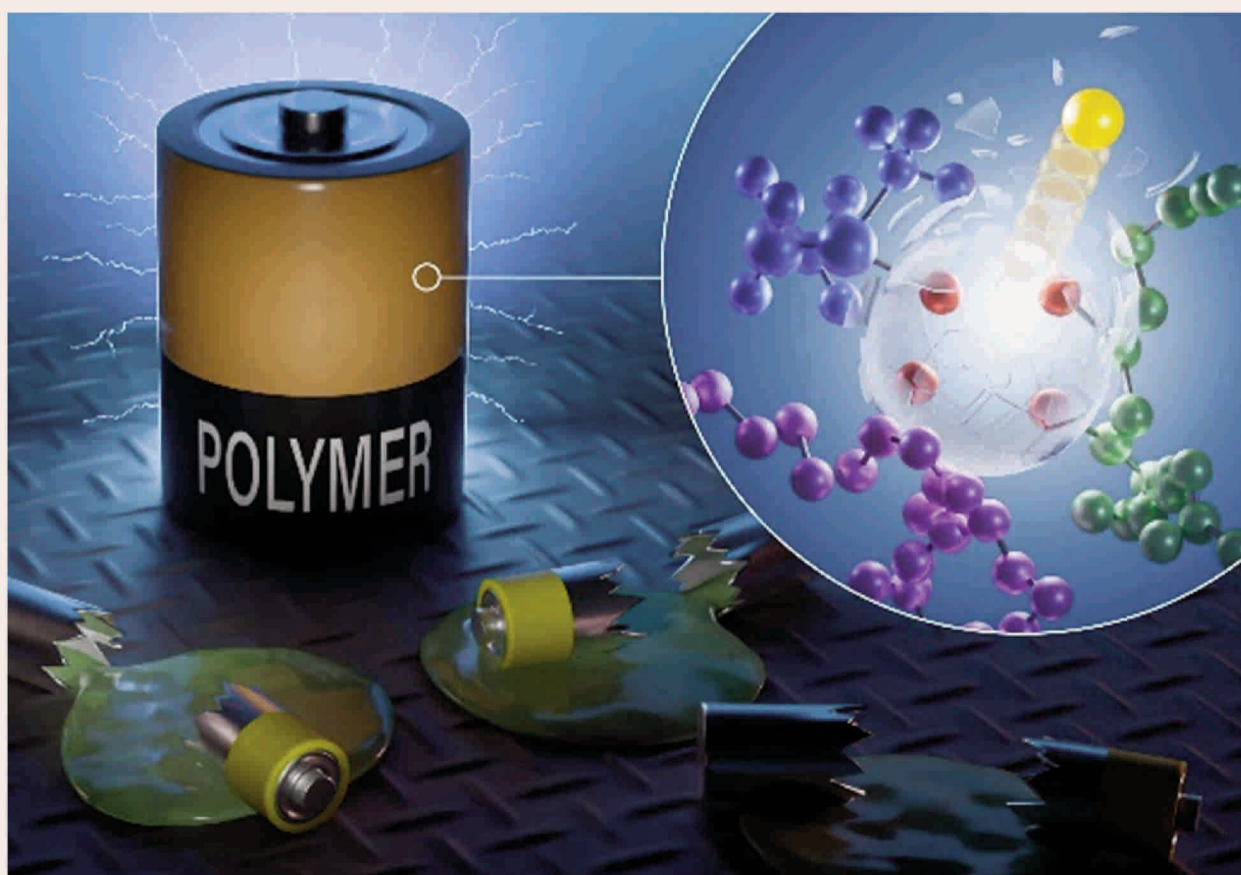
The rate at which ions in any battery break free from such environments, or solvation cages in polymer electrolytes, helps determine how energy flows through the battery.

Polymer electrolytes could enable more energy-dense electrodes, like lithium metal, resulting in more powerful lithium batteries.

The findings also open doors for rapidly screening new battery materials at ORNL.

"Neutrons are highly sensitive to hydrogen, which is present in virtually all electrolytes. This allowed us to see how it moved in the system and understand polymer electrolyte dynamics at an unprecedented level of detail. We couldn't have pinned down the time and length any other way," said Naresh Osti, ORNL neutron scattering scientist.

"Naresh and Eugene's interpretation of neutron data



from the experiment at ORNL opened our eyes to understanding the extent to

which lithium ions are caged in polymer electrolytes. Our findings suggest this general

approach will apply to liquid electrolytes," said Nitash Balsara, Charles W. Tobias

Professor of Electrochemistry at the University of California, Berkeley.