

FORTNIGHTLY ENGINEERING REVIEW

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Founded by Najam ul Hassan (March 2001)
 Vol. 49 No. 24 December 16-31, 2024
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Unlocking Pakistan's EV Potential: A Comprehensive Roadmap for Growth

The transition to electric vehicles (EVs) represents a significant opportunity for Pakistan, combining both environmental and economic benefits. However, the country faces numerous challenges as it works toward this vision, according to a recent policy viewpoint from the Pakistan Institute of Development Economics (PIDE). The viewpoint, authored by senior economic researcher Dr. Usman Qadir, research fellow Mohammad Shaaf Najib, and assistant chief (policy) Saddam Hussain, outlines several barriers that must be addressed for the successful implementation of an EV-driven future.

Key Challenges for EV

Adoption

- High Production Costs** One of the primary obstacles for EV adoption in Pakistan is the high cost of production. The technology to assemble and manufacture EVs in Pakistan is still in its early stages, leading to expensive production processes. Additionally, the country's reliance on imports and lack of associated industries have driven up production costs. High import tariffs further exacerbate the situation, making EVs significantly more expensive than their internal combustion engine (ICE) counterparts.
- Limited Vehicle Ownership** While 61% of Pakistani households own a personal vehicle, the majority of these are two-wheelers, such as motorcycles. Only 6% of households own passenger cars. This limited market for passenger vehicles, combined with the high initial cost of EVs,

- Range Anxiety and Charging Infrastructure** Range anxiety—concern about running out of battery while driving—remains a significant barrier to EV adoption. This is compounded by the lack of widespread charging infrastructure. Recharging takes longer than refueling a conventional vehicle, and the fear of being stranded without a charging station is a major deterrent for potential EV buyers.
- Low Production Volumes and Capacity** Pakistan's automobile industry currently operates on a small scale, primarily serving local demand. This limits the ability of manufacturers to reduce costs through economies of scale. The country's auto parts manufacturers also lack the

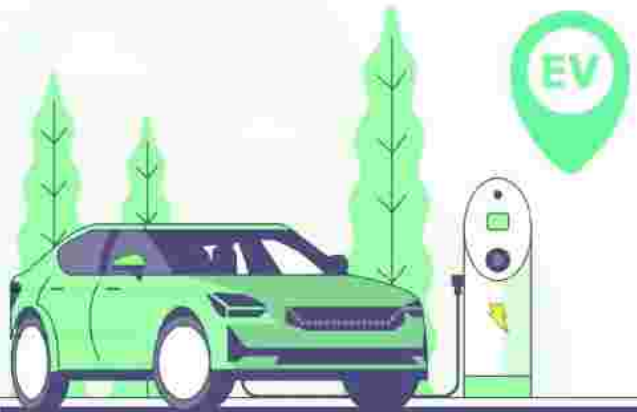
- Global Isolation** Unlike many countries that have integrated into the global value chain for automobile manufacturing, Pakistan's auto industry has remained largely isolated. This has prevented local manufacturers from accessing advanced technologies and quality production techniques, which are crucial for producing competitive EVs.

Policy Recommendations

To overcome these challenges, PIDE recommends several policy objectives:

- Increase Vehicle**

Contd on page 2



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Unlocking Pakistan's EV Potential: A Comprehensive Roadmap for Growth

Contd from page 1

Ownership There is a need to expand vehicle ownership in Pakistan, especially EVs, by making them more accessible through incentives and subsidies. The aim is to make EVs widely available, especially in the two- and three-wheeler and passenger car segments.

2. Enhance Charging Infrastructure A nationwide network of EV charging stations must be established to alleviate concerns about range anxiety. Policies should encourage commercial, residential, and mixed-use properties to install charging stations, and existing petrol stations should be retrofitted with EV chargers.

3. Boost Local Manufacturing and Production Pakistan needs to significantly enhance its EV manufacturing capacity. The government should offer tax incentives to encourage the establishment and expansion of local manufacturing units. This would reduce dependence on imports and help achieve economies of scale, ultimately lowering production costs.

4. Incentivize EV Adoption To encourage EV adoption, PIDE suggests offering substantial tax concessions on EV imports and locally manufactured vehi-

cles, especially for government purchases. Special incentives could also be offered for the use of EVs in commercial transport, including buses and trucks.

5. Strengthen Local Supply Chains A thriving local supply chain is crucial for the success of EV manufacturing in Pakistan. The government should incentivize the development of a competitive supply chain, ensuring that local auto parts manufacturers are integrated into the global value chain for parts and components.

6. Labor and Training Initiatives Developing a skilled workforce is essential for the growth of the EV industry. The government should invest in vocational training and higher education to produce engineers and technicians who are proficient in EV technology and manufacturing.

7. Green Financing The State Bank of Pakistan should establish green financing programs to support EV manufacturers and buyers. This would provide financial support for the growth of the EV sector and help make EVs more affordable for consumers.

Long-Term Goals
To align with international best practices, PIDE outlines specific targets for

EV adoption and production:

- By 2030, 10% of new 4-wheel passenger car sales should be EVs, and 25% of new 2- and 3-wheeler sales should be EVs.
- By 2040, 50% of all new 4-wheel passenger car sales should be EVs, and 75% of 2- and 3-wheeler sales should be EVs.
- By 2035, 50% of locally produced 4-wheel passenger cars and 2/3-wheelers should be EVs.
- By 2030, 10% of all EVs produced in Pakistan should be exported, increasing to 50% by 2040.

Conclusion
The transition to electric vehicles in Pakistan presents a tremendous opportunity, but it is clear that achieving this vision requires overcoming substantial challenges. By adopting a multi-pronged approach focusing on production, import, adoption, and infrastructure development, Pakistan can pave the way for a cleaner, more sustainable future. The success of this transition will depend on government policies that support local manufacturing, incentivize EV adoption, and establish a robust infrastructure for the growing EV market. -- ERMD

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Reko Diq Mining Completes Environmental and Social Impact Assessment

Reko Diq Mining Company (RDMC), in line with

studies, working closely with local communities, environmental organizations, and government stakeholders.

to manage risks, while maximizing the positive impacts of the project and minimizing potential negative effects."

under review by regulators in Balochistan and Sindh, as well as by an internationally recognized independent company.

In line with Barrick's policy, RDMC remains committed to responsible resource development and aims to create value for local

communities through job creation, infrastructure development, and environmental stewardship. -- ERMD/APP/PR



its commitment to responsible and sustainable mining practices, has completed the Environmental and Social Impact Assessment (ESIA) for its project. The comprehensive assessment has been submitted to the relevant government authorities for their review and approval.

The ESIA is a critical step in ensuring that RDMC's operations meet the highest global environmental and social standards. Over the course of 2.5 years, a team of independent experts conducted thorough social and environmental

These studies evaluated the potential environmental and social impacts of the project, including effects on air quality, water, biodiversity, and local populations' well-being, as noted in a recent news release. The project design incorporates a mitigation hierarchy, with ongoing management plans to address any identified impacts.

"We are fully committed to the sustainable development of our project, and the completion of this ESIA marks a major milestone in ensuring our operations are both environmentally responsible and beneficial to the communities we work with," said Ashley Price, ESIA Manager for RDMC.

"The insights from these studies will guide our efforts

This ESIA complies with the regulatory requirements of the Balochistan Environmental Protection Act (2012) and Sindh Environmental Protection Act (2014). It also aligns with the International Finance Corporation's (IFC) Performance Standards on Environmental and Social Sustainability (2012), the World Bank Group's Environmental, Health, and Safety (EHS) Guidelines, the Equator Principles, and the Global Industry Standard for Tailings Management (GISTM).

Throughout the process, RDMC has engaged continuously with local communities and other key stakeholders to ensure their concerns are reflected in the impact assessment.

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4th consecutive win in a row! Pakistan Cables Wins Prestigious Corporate Excellence Awards 2024

Pakistan Cables Limited has once again achieved a remarkable milestone by winning the 39th Corporate Excellence Award 2024 in the Cables and Electrical Goods category. This marks the fourth consecutive year that Pakistan Cables has been recognized for its exemplary performance. The award was presented during a prestigious ceremony organized by the Management Association of Pakistan (MAP) in Karachi.

Waqas Mahmood, Chief Financial Officer of Pakistan Cables Limited, received the award on behalf of the company from Syed Murad Ali Shah, Chief Minister of Sindh, who graced the occasion as the Chief Guest. This recognition reaffirms Pakistan Cables' dedication to setting new benchmarks in corporate governance and operational excellence.



Mr. Fahd K. Chinoy, CEO of Pakistan Cables, address at the ceremony, highlighting Pakistan Cables as a case study on

change management in the corporate sector.

The Corporate Excellence Awards was instituted by MAP in 1982 to recognize and honour companies in Pakistan that demonstrate outstanding performance, progress, and enlightened management practices consistently.

Founded in 1953, Pakistan Cables is the premiere and most reputable cable manufacturer in Pakistan. It is the first and oldest wires and cable manufacturer listed on the PSX since 1955. It is also a member company of the Amir S. Chinoy (ASC) group. The company has the largest geographical footprint in Pakistan with a presence in over 180 cities. It is ISO9001:2015, ISO 14001:2015 AND OHSAS 18001:2007 certified and various cable types tested by KEMA, Netherlands. Pakistan Cables is the only building material company in Pakistan that has its carbon emission reduction targets approved and validated by SBTi. — PR

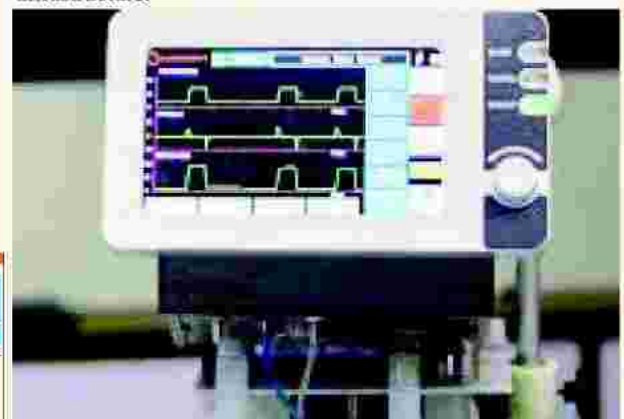
Pakistan's AlnoVent AVB-100 ICU Ventilator Receives Regulatory Approval, Set for 2025 Market Launch

Alsons Group, a trailblazer in precision engineering and manufacturing in Pakistan announced last week that its flagship product, the AlnoVent AVB-100 ICU Ventilator, has successfully received regulatory approval from the Drug Regulatory Authority of Pakistan (DRAP).

This momentous development sets the stage for the ventilator's market release in 2025, positioning Pakistan as an emerging contender in the global medical device industry, the company said in a press release to the media.

The AlnoVent AVB-100 is an advanced electro-mechanical ICU ventilator that has been meticulously designed, developed, and manufactured by the Alsons Group to meet stringent international standards of quality and performance. It features a versatile range of functions, offering five invasive and two non-invasive ventilation modes, making it adaptable for various critical care situations.

This innovation was born out of the dire need for respiratory devices during the COVID-19 pandemic, with Alsons Group committed to strengthening the country's healthcare infrastructure.



"We take immense pride in the fact that the AlnoVent AVB-100 is the first electromedical device in Pakistan to successfully navigate the rigorous approval process, including clearance from the National Bioethics Committee (NBC) and DRAP," said Akbar Allana, Director of Alsons Group.

The development of the ventilator included a thorough clinical trial conducted at Jimah Medical Hospital and Allama Iqbal Medical College, Lahore, under the NBC's Terms of Reference (ToR). A detailed baseline study, compiled with the support of the Data and Safety Monitoring Board (DSMB), will serve as a foundation for future research and studies in this area.

Founded in 1953, Alsons Group has built a stellar reputation in precision engineering and technology innovation across industries such as automotive, aerospace, defense, lighting, and healthcare. Leveraging this expertise, the company ventured into medical technology, showcasing Pakistan's potential for cutting-edge technological development.

"We are proud to offer a locally produced solution to meet critical healthcare needs," Akbar Allana added. "The AlnoVent embodies our commitment to innovation and demonstrates Pakistan's capacity to make significant contributions to global healthcare challenges."

With the approval and upcoming release of the AlnoVent AVB-100, Alsons Group marks a historic achievement, underscoring Pakistan's self-reliance and ingenuity in medical technology. This milestone signifies the nation's growing role in the global healthcare sector. — PR/ERMD

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- Richard Branson

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PTCL First in Pakistan to Achieve Prestigious EPI Data Centre Certification

Pakistan's leading telecom and integrated ICT services provider, Pakistan Telecommunication Company Limited (PTCL) has raised the data centre industry benchmark by achieving the prestigious TIA-942-C data centre certification form Enterprise Products Integration (EPI) – a global leader in data center certification.

The meticulously audited and certified milestone underscores PTCL's unwavering dedication to excellence and innovation in the mission-critical data centre industry in Pakistan. PTCL's state of the art data centers offer rack hosting services designed to accommodate servers, networking devices, and other data center computing equipment. The purpose-built facilities provide carrier customers with a secure, cost-effective, and space-efficient solution for housing essential infrastructure.

Strategically located in major cities across Pakistan, the data centers ensure high levels of security, resilience, and flexi-

bility, helping businesses reduce costs, enhance IT value, and maintain efficient operational footprint. Commenting on the development, Jafar Khalid, Group Chief

Officer, PTCL said, "This achievement further solidifies PTCL's position as a leader in the digital infrastructure landscape. This recognition is a proud moment for our team, acknowledging our commitment to excel-

the industry, delivering services that meet the highest global standards.

PTCL's data centres enable enterprise customers through provision of secure environment for storing, processing, and managing data, with centralised management, disaster recovery, and backup power solutions. It also offers scalability, enhance security compliance, support cloud services, and help businesses avoid the high costs of building and maintaining their own infrastructure, so they can invest precious resources in growing and sustaining their business, while relying on a trusted partner such as PTCL.

Nausheen Ashraf, Country Manager, EPI Pakistan and Central Asia extended heartfelt congratulations to PTCL for achieving the esteemed TIA-942-C Data Center Certification. She Said, "This accomplishment is a testament to PTCL's sustained commitment to upholding the highest standards of excellence and innovation in data center services since their first certification in 2009. We as EPI commend PTCL's dedication to providing secure, resilient, and world-class data center solutions for businesses across Pakistan, solidifying their position as an industry leader."



Technology and Information Officer, PTCL and Ufone 4G said, "The prestigious EPI certification not only raises the bar for data centre standards in Pakistan but also solidi-

ty, cementing our position as a leader in

OGDCL Revives Heavy Oil Well in Chakwal, Enhances Production at Rajian Oil Field

Oil and Gas Development Company Limited (OGDCL), Pakistan's leading exploration and production company, has successfully revived a heavy oil well in the Northern Region field, marking a significant milestone in the nation's energy sector.

The initiative was undertaken at the Rajian Oil Field located in the Gujjar Khan Exploration License (E.L.), District Chakwal, and is part of OGDCL's strategic moves to enhance production capabilities. Previously, the field's four heavy oil-producing wells were contributing 1,500 barrels per day (BPD). With the successful completion of the revival process,

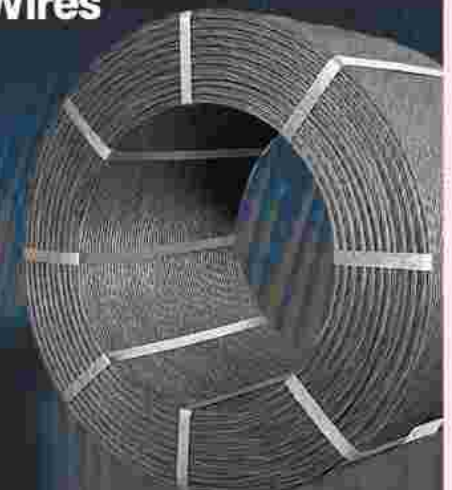
cumulative production from the Rajian Oil Field has now surged to 2,500 BPD.

OGDCL developed a robust optimization plan for the Rajian field, including 11 workover jobs and the deployment of advanced artificial lift systems. Rajian-3A, the first target of this initiative, reaches a depth of 3,652 meters. The well had been temporarily suspended in 2020 due to formation challenges. Employing an innovative approach, OGDCL completed the well using an Electrical Submersible Pump (ESP) in the Chor-gali-Sakessar and Tobra formations. This effort successfully revived production at the well, augmenting output to 1,000 BPD.

The optimization program for the remaining 10 wells is underway, and OGDCL anticipates a sig-

nificant boost in production from the Rajian field. Furthermore, OGDCL-owned Rig N-4, deployed for the implementation of the innovative program, will remain at the Rajian field for the entire duration. The expected outcomes will be shared with shareholders upon completion of these operations, reflecting the company's commitment to maximizing asset potential and ensuring value creation. This achievement underscores OGDCL's commitment to operational excellence and sustainable energy development. By leveraging innovative technologies and optimizing asset potential, OGDCL continues to play a crucial role in strengthening Pakistan's energy security and solidifying its position as a leader in the hydrocarbon sector. -- ERMD

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Erasmus Plus Catch VR Project Workshop on AR/VR Technologies Towards Digital Twin

The Department of Electronic Engineering organized an insightful one-day

workshop on Augmented Reality (AR) and Virtual Reality (VR) technologies in the context of Digital

Twins. This workshop was conducted in collaboration with the Erasmus Plus EU Co-funded Capacity Building in Higher Education (CBHE) CATCH_VR proj-



ect and aimed to equip participants with advanced knowledge in AR/VR applications.

Professor BS Chowdhry, the Coordinator of the EU-


AR/VR Applications and Digital Twins. The attendees gained practical experience and insights into the latest AR/VR technology advancements and their applications

the CATCH_VR project. The aim of the "Capacity building in Teaching of AR/VR (CATCH_VR)" project is to enhance the capacity of higher education institu-



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funded CATCH_VR project, graced the event and expressed his gratitude for the successful collaboration between the Department of Electronic Engineering and

UET PAFK



the CATCH_VR project. He commended the department for facilitating such a valuable learning and knowledge exchange opportunity.

in creating and managing Digital Twins.

After the workshop, Dr. Aneel Kumar, Pro Vice Chancellor of MUET, presented shields to the main

tions through Augmented Reality (AR) and Virtual Reality (VR) using Digital Twinning, with a consortium of several educational institutions from Europe and Asia

speaker, Dr Shoaib Rehman Soomro, and other resource people to recognize their valuable contributions to the event's success.

focusing on Graduate Engineering Education. The project involves a participatory learning approach, practical demonstrations and hands-on



The workshop covered a range of cutting-edge topics, including 3D Display and 3D Imaging Technologies for AR/VR, Hands-on Demo of the Meta Quest VR Headset, creating 3D Content for AR/VR using Unity 3D,

This workshop was an essential step in fostering the development and adoption of AR/VR technologies in academic and industrial settings, marking a significant milestone for both the Electronic Engineering Department and

experience with physical equipment and digital twins. This project shall produce trainers who will ultimately train the mean power for higher education to STEM-based training using low-cost Digital Twin. ■

Focusing Health, Infrastructure, Agriculture

Govt Approves Multibillion-Rupee Development Projects



The Central Development Working Party (CDWP) has approved 15 development projects with a total worth of Rs 422.704 billion. Among these, the Khawazakhela-Besham Expressway, valued at Rs 137.711 billion, is a key project. The meeting, chaired by the Minister for Planning Development and Special Initiatives, Ahsan Iqbal, saw approval for nine projects totaling Rs 17.95 billion. Additionally, nine projects worth Rs 404.754 billion were recommended to the Executive Committee of the National Economic Council (ECNEC) for further consideration.

The approved projects span various sectors, including Health, Agriculture, Environment, Governance, Water Resources, Transport, Communication, and Science and Technology. Among the notable projects referred to ECNEC for further review:

1. **Khawazakhela-Besham Expressway** (Rs 137.711 billion): This project, financed by the Public Sector Development Program (PSDP), includes the construction of a 48-km expressway with bridges, tunnels, retaining walls, drainage systems, toll plazas, and roadside facilities to enhance regional connectivity and infrastructure.

2. **Procurement of Wagons and Coaches for Pakistan Railways** (Rs 70.968 billion): Aimed at modernizing Pakistan Railways, this project involves the procurement of 820 high-capacity bogie wagons and 230 passenger coaches to improve freight and passenger services.

3. **Sindh Coastal Resilience Project (SCRIP)** (Rs 45.792 billion): Financed by the International Fund for Agricultural Development (IFAD), this project focuses on building climate resilience and improv-

ing livelihoods in the coastal districts of Sindh, including Badin, Sujawal, and Thatta.

4. **Rawalpindi Ring Road** (Rs 32.997 billion): This project involves constructing a 38.3-km carriageway with interchanges, bridges, flyovers, and toll plazas to enhance connectivity between major roads. It is designed according to AASHTO highway standards.

5. **Economic Transformation Initiative for Gilgit-Baltistan** (Rs 26.764 billion): Aimed at improving incomes and reducing poverty in rural Gilgit-Baltistan, this initiative will focus on agricultural development, rural infrastructure, and the value chain for products like apricots and potatoes.

6. **Khyber Pakhtunkhwa Revenue Mobilization Program** (Rs 4.714 billion): This technical assistance project will help improve revenue mobilization and public resource management in the province.

Additional approved projects include:

- **Jinnah Medical Complex and Research Centre** (Rs 3.11 billion)
- **Social Sector Accelerator Program** (Rs 7.5 billion): Aimed at providing 30,000 paid internships for fresh graduates in health, education, and other sectors.
- **Multan-Vehari Road Rehabilitation** (Rs 12.887 billion): Referring to ECNEC for further review.
- **Mangi Dam and Water Conveyance System** (Rs 18.995 billion): A major project to build a dam and convey water to Quetta City, addressing regional water scarcity.

Other projects related to infrastructure and IT, including a new air traffic control tower at Karachi's Jinnah International Airport and IT strengthening initiatives for the Ministry of Planning, have also been approved. -- ERMD

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Nanotechnology: Revolutionizing Engineering at the Miniature Dimension

Engr. Dr. Muhammad Nawaz Iqbal

The study of materials manipulation at the nanoscale, or nanotechnology, is a branch of science and engineering that is completely changing the way we solve small-scale technical problems. Material characteristics and behaviors at the nanoscale are distinct from those at the macroscale. With this scale of matter manipulation, previously unimaginable opportunities for building and constructing new materials, gadgets, and systems with improved functionality and performance have become available. Nanotechnology is

based on the modification of individual molecules and atoms. The materials used by researchers and engi-

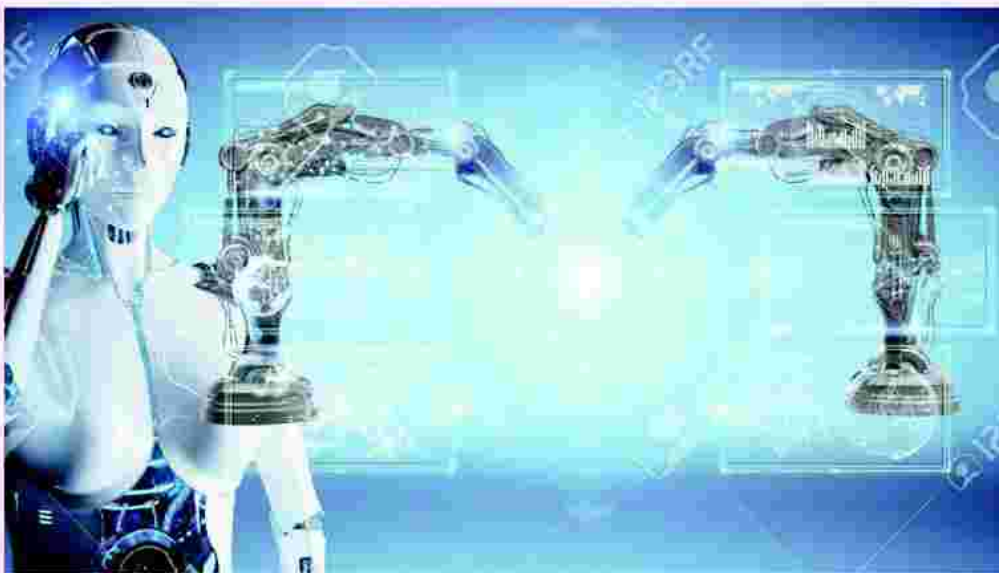
including mechanical strength, optical behavior, and conductivity when the quantum effects take center

features for particular uses. One of the main uses of nanotechnology is the creation of nanoparticles with

greatly aided by nanotechnology. Energy storage devices, catalytic converters, and solar cells can all operate more efficiently when nanomaterials are used. For example, quantum dots are semiconductor particles at the nanoscale that may be designed to absorb particular light wavelengths, which makes them useful parts of solar cells. In a similar vein, nanocatalysts increase chemical process efficiency, which lessens environmental impact and produces cleaner energy. In order to create extremely sensitive sensors and actuators, the discipline of nanoelectromechanical systems investigates the combination of nanotechnology with micro-electromechanical systems. Because nanoelectromechanical systems devices function at the nanoscale, they can sense and act with previously unheard-of precision. These devices find use in fields where their tiny size and great sensitivity are beneficial, such as telecommunications, environmental monitoring, and healthcare. Since nanotechnology offers solutions to problems with pollution, resource use, and waste management, it has significantly improved environmental sustainability. Effective air filtration, water purification, and polluted site cleanup are all possible with nanomaterials. Pollutants can be broken down by nanoparticles with catalytic qualities, and environmental parameters can be monitored in real time with nanosensors. Nanotechnology offers a plethora of opportunities for sustainable solutions, including instruments to lessen the environmental impact of human activity.



of nanotechnology across a range of industries. A novel method of computation that makes use of quantum physics, quantum computing is another area where nanotechnology has great potential. Examples of nanoscale components being investigated for their possible use in quantum information processing are quantum dots and superconducting nanowires. Potentially solving some problems tenfold quicker than classical computers, quantum computing could lead to new developments in areas like materials research, cryptography, and optimization. Notwithstanding the encouraging developments, there are still difficulties and moral dilemmas in the realm of nanotechnology. Research and discussion on the possible toxicity of specific nanomaterials, their effects on the environment, and the ethical ramifications of privacy and security are ongoing. To ensure the appropriate development and implementation of nanotechnological applications, it is imperative to take into account the ethical, sociological, and environmental consequences of nanotechnology as it continues to advance. With its unparalleled ability to alter and engineer substance at the nanoscale, nanotechnology is a revolutionary force in engineering. Nanotechnology has impacted a wide range of industries, including healthcare, electronics, energy, and the environment. It has spurred innovation and opened up new avenues for scientific research. The continuous investigation of phenomena at the nanoscale and the creation of nanomaterials have the power to transform entire industries, provide fresh answers to urgent problems, and enhance science and technology. ■



neers in the aforementioned field are at the nanoscale, usually between 1 and 100 nanometers. This scale causes changes in qualities

stage. These qualities may be precisely controlled thanks to nanotechnology, which makes it possible to create materials with unique

unique characteristics. Materials that use nanoparticles to improve their thermal, mechanical, or electrical qualities are called nanocomposites. Graphene and carbon nanotubes are two examples of carbon-based nanostructures with remarkable electrical, thermal, and mechanical conductivity. These materials have been used in a variety of fields, including electronics and aerospace, where their special qualities are used to enhance performance. Drug distribution, personalized therapy, and diagnostics have all advanced as a result of the medical field's transformation thanks to nanotechnology. The cellular or molecular level of biological systems can be interfaced with through the engineering of nanoscale devices and particles. Under the field of nanomedicine, drugs can be delivered precisely and with little adverse effects by using nanoparticles. Furthermore, extremely specific and sensitive biomolecule detection is made possible by Nano sensors, which transforms early illness detection and diagnostic methods. Nanotechnology's ability to miniaturize electronics has resulted in the creation of smaller, quicker, and more energy-efficient gadgets. Integrated systems with nanoscale characteristics can now be produced thanks to the semiconductor industry's use of nanoscale fabrication techniques. Moore's Law-driven ongoing downsizing has been the primary driver of the exponential rise in computing power and the pervasive use of portable electronics. The development of engineering technologies is

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LOVE FOR WOMEN

By Muhammad Tariq Haq | ESL

Beautiful for men is love for women
— Children, heaps of silver, gold, and opulence.

Cattle, fields ripe for harvest,
— Villas and vast mansions
In great abundance.

Branded horses, in past nations;
— BMWs, Mercedes Benz, and others at present.

These are delights of this fleeting existence,
— But with God lies the finest dividends.

There are gardens with rivers flowing under them,
— Inhabited by pure and pristine women,
Of the same age as their eternal husbands.

Meant for believing men who seek God's repentance
— and From the punishment of the fire,
their deliverance.

These are patient, truthful, and obedient,
— From their wealth, they generously spend.

In early hours, long before the day begins,
— They forsake their bed and repent.

They don't even approach the indecent,
— Nor gaze with greed towards the forbidden
Or others' possessions.

Strong lust for each other is a natural instinct
Between men and women
— Within limits, it is cherished in every religion.

Men have, over women, little preference;
On both of them, apply the holy guidance.

Men and women should lower their gaze from the forbidden.
— In addition, women must keep their attraction
Under a veil hidden.

There is pleasure beyond measurement
For men in women,
— And for women in men, immense enjoyment.

Permissible only in a wife and husband's intimate moments
— Beyond this, it is great disobedience.

Within this world and the life
Which will never end,
— Such choices bear grave consequence!

Unless followed by instant repentance
— And true abstinence!

HVACR Society, Karachi Chapter, organized a technical tour at Shan Industries for the students of St. Patrick's Institute of Science & Technology

Farukh Ashraf, Honorary Coordinator Student Affairs & Head Seminar Committee,

led an in-depth demonstration of advanced HVAC and ducting fabrication systems. The students gained invaluable insights into the latest



Pakistan HVACR Society, Karachi Chapter, organized a technical tour at Shan Industries for the stu-

technologies and operational innovations in the HVAC era. On this occasion, Ahmed Rizwan, CEO, Shan Industries, welcomed



dents of St. Patrick's Institute of Science & Technology. Zafar Ahmed Syed, Manager Sales & Marketing, provid-

ed the students and said that we will always grant access for technical visits and will share the knowledge of the HVAC field.

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SAF is Pakistan's Answer to Climate Change and Possible Flight Ban

By Ahsan Jalal



"France recently banned short-haul flights to cut carbon emissions, a move that Pakistan might face if it doesn't advance Sustainable Aviation Fuel (SAF) initiatives", according to Mr Ali Abdullah, the country sales manager of Axens, a solution provider for sustainable technologies. In a discussion about the future of biofuels in Pakistan, Abdullah emphasized the urgency of transforming the aviation sector into a sustainable and eco-friendly enterprise amid geopolitical changes and rising carbon emissions.

The aviation industry is crucial for global connectivity and economic development. However, rapid changes in geopolitical conditions and increasing carbon emissions pose significant threats to Pakistan's already fragile economy. As the world faces the consequences of climate change, there is an urgent need to transform the aviation sector into a sustainable and eco-friendly enterprise. A key solution is the investment in and widespread adoption of Sustainable Aviation Fuels (SAFs). SAFs are categorized into net carbon-neutral drop-in fuels like synthetic or bio-fuels and non-drop-in fuels like hydrogen. Widely used by airlines globally, SAFs comply fully with aviation fuel standards (certified under ASTM D7566 specifications) and can be blended with conventional jet fuel for immediate use. They are also compatible with existing aircraft engines and airport fuel infrastructure.

Various technologies are being developed to convert different feedstocks into jet fuel. Alcohol-to-jet technologies, which use feedstocks ethanol derived from first-generation feedstock: sugar cane (molasses), maize, or

second-generation feedstock: lignocellulose biomass like bagasse, rice straw, wheat straw, banana leaves etc. These technologies are supported by entities such as DARPA and the U.S. Navy and have commercial partnerships with companies like Boeing and Virgin Atlantic. Hydro-processed ester and fatty acids processes (HEFA) utilize waste oil and vegetable oils, backed by the U.S. Navy and NASA, with partners including Lufthansa and GE Aviation. Catalytic Hydrothermalolysis and Hydrotreated Depolymerized Cellulosic Jet technologies, funded by the FAA, involve companies such as Rolls-Royce. Gas-to-jet methods use biogas, supported by the U.S. Department of Energy, with commercial partners like Qatar Airways. Sugar-to-Jet and Direct Sugar Biological to Hydrocarbons involve advanced catalytic and biological processes, supported by the U.S. Navy and FAA, with partnerships with companies like Embraer and Azul Airlines. However, Mr Abdullah emphasized that HEFA processes are more beneficial for Pakistan due to their mature and proven technology, availability of huge amounts of cooking oil and comparatively lower investment requirements. When inquired about ethanol, he mentioned that it is preferable to use it for gasoline blending to reduce the import bill or for export purposes on a short-term basis until HEFA feedstock is spent then alcohol to jet may be needed.

While answering the financing issue for funding SAF's plants in Pakistan, He asserted that currently, it's very difficult to get financial support for the project based on fossil fuels. However, the Asian Development Bank and other finance institutions are very keen to support projects focused on reducing carbon emis-

sions. On the profitability of the projects, he mentioned that the export-oriented manufacturing of SAFs is more beneficial as there are a lot of incentives for export-oriented companies in Pakistan.

Reflecting on the potential advantages of Sustainable Aviation Fuels (SAF) for Pakistan, Mr Abdullah highlighted the following points:

Reducing Carbon Emissions: The aviation industry is a significant contributor to greenhouse gas emissions, with conventional jet fuels being a major source of carbon dioxide. SAFs, derived from renewable resources such as biomass, waste oils, water, and algae, offer a viable alternative. These fuels can reduce carbon emissions by up to 65%, aligning with global efforts to achieve carbon neutrality and meet national emission reduction targets. This will also provide Pakistan with valuable carbon credits for trading and earning foreign exchange.

Economic Advantages: Besides environmental benefits, investing in SAFs offers economic advantages. Traditional jet fuels are susceptible to price fluctuations due to volatile oil prices, geopolitical uncertainties, and the finite nature of fossil fuel resources. In contrast, SAFs provide a more stable and predictable fuel source. Airlines are investing in SAFs to appeal to environmentally conscious travellers and avoid carbon taxes. In the future, airlines using conventional fuels may face bans or penalties in regions like the European Union. Pakistan could lose revenue if such measures are implemented, investing in SAFs is crucial for future-proofing the aviation industry and positioning it as a responsible global player.

In addition to these highlighted points, I

believe that we must be forward-looking to meeting Strategic Needs. Military operations are energy-intensive, with aviation playing a critical role in rapid deployment, strategic reconnaissance, and tactical support. Conventional jet fuels, mostly based on imported crude in Pakistan, pose risks of fuel scarcity and high costs during operations. Given India's increasing influence, there could be embargoes on crude oil imports during conflicts. Additionally, reliance on foreign technologies can hinder military operations if embargoes are placed on importing catalysts or other technological equipment. Investing in SAFs ensures a diversified and sustainable energy supply for military aviation, mitigating the risks associated with dependence on traditional fossil fuels.

In conclusion, the imperative to invest in Sustainable Aviation Fuels (SAFs) is clear and multifaceted. SAFs offer a viable solution to reducing carbon emissions, a crucial step in combating climate change and aligning with global carbon neutrality goals. Economically, SAFs provide stability in a market plagued by volatile oil prices and geopolitical uncertainties, ensuring a more predictable fuel source for airlines. Strategically, SAFs secure a diversified and sustainable energy supply, critical for both commercial and military aviation in Pakistan. Furthermore, the development and adoption of SAFs will drive technological innovation, enhance local expertise, and create job opportunities. By committing to SAF initiatives, Pakistan can future-proof its aviation industry, meet national and international environmental standards, and position itself as a forward-thinking, responsible global player. ■

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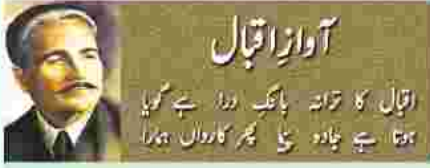
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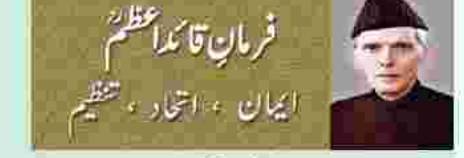
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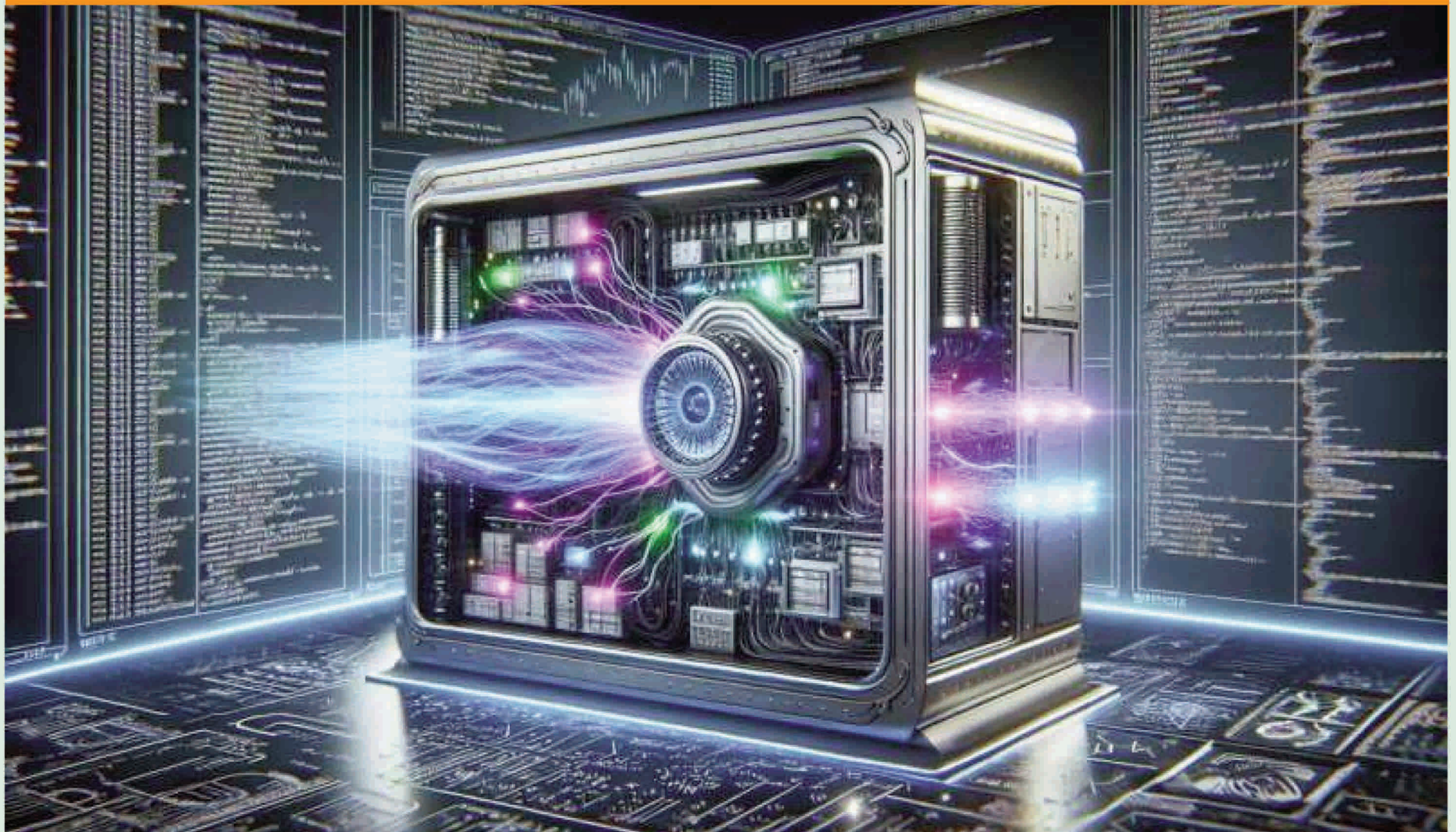
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تھا مگر مسافر راغب نہیں ہوئے۔ ریلوے کی ہزاروں مسافر بوگیاں اور مال
گاڑی کے ڈبے ناکارہ پڑے ہیں جو تباہ حال اسکرپٹ بن چکا ہے مگر محکمہ
ریلوے یہ اسکرپٹ فروخت نہیں کر رہا جو اربوں روپے مالیت کا ہے۔
ریلوے میں بوگیوں کی کمی ہے اور ضرورت پر کباز میں لاوارث پڑی وہ
بوگیاں کام میں آجاتی ہیں جو بالکل ناکارہ اور ناقابل استعمال نہیں ہوئیں اور
ضرورت پر انھیں اسی بوسیدہ حالت میں استعمال بھی کر لیا جاتا ہے۔ کراچی
میں ایک بار اے سی اسٹینڈرڈ کی بوگی کم ہونے پر اے سی بزنس کی بوگی وہاں
لگائی گئی تھی اور اے سی اسٹینڈرڈ کے مسافروں کو اے سی بزنس کلاس میں سفر
کرایا گیا تھا۔ نومبر کو لاہور سے کراچی جانے والی کراچی ایکسپریس میں اے
سی اسٹینڈرڈ کی بوگی کم پڑ گئی تو لاہور میں پڑی ایک پرانی بوگی ریلوے
افسران کو یاد آگئی جسے ڈھائی گھنٹے تاخیر سے چلنے والی ٹرین میں بغیر صفائی
کرائے لگا دیا گیا جس کا اے سی تو چل رہا تھا مگر بند کھڑکیوں پر مٹی جمع تھی
جس پر کپڑے لکڑے موجود تھے جو مسافروں پر چڑھ کر انھیں پریشان کر
رہے تھے اور یہ پرانی بوگی ایک بہتر بوگی کے ساتھ پاروین اور ڈرائنگ کار
کے ساتھ لگائی تھی جس کے نوائلٹ کی کسی ٹوٹی پانی آ رہا تھا تو دوسری کام
نہیں کر رہی تھی۔ اس بوگی کے اندرونی دروازے بالکل کام نہیں کر رہے اور
بیرونی بڑے دروازے پڑے پڑے ناکارہ ہو چکے تھے۔ شام چھ بجے چلنے
والی بیڑن لاہور سے ساڑھے آٹھ بجے چلی جس نے لیٹ ہوتے ہوتے
سولہ گھنٹے کا سفر چھپیں گھنٹوں میں مکمل کیا۔

ریلوے میں یہ بھی ہو رہا ہے کہ ٹریینوں کی کمی کی وجہ سے بوگیوں کی تعداد
بڑھادی جاتی ہے جن میں اے سی بوگیاں سب سے آگے یا سب سے پیچھے
لگائی جاتی ہیں اور کراچی اور لاہور پہنچنے پر اے سی بوگیوں کو پلیٹ فارم بھی میسر
نہیں آتا اور یہ لمبی بڑی ٹرینیں پلیٹ فارم سے باہر روانہ اور اسی طرح منزل
پر پہنچتی ہیں جس سے زیادہ کرایہ دے کر سفر کرنے والے مسافر پریشان
ہوتے ہیں۔ ٹریینوں میں صفائی اے سی بزنس میں تو ہوتی ہے مگر اے سی
اسٹینڈرڈ کی حالت بھی اب اکنامی بوگیوں جیسی ہو گئی ہے جب کہ اکنامی
کلاس میں نہ مناسب روشنی ہوتی ہے نہ صفائی اور ٹوائٹلٹس میں اندر پانی ملتا
ہے نہ کنڈی لگانے کے لیے دستیاب ہوتی ہے۔ لاہور سے کراچی آنے والی
ٹرین میں پانی ختم ہو جائے تو حیدرآباد میں پانی نہیں بھرا جاتا۔ سفر کے دوران
فراہمی آب پر توجہ نہیں دی جاتی اور درمیان میں آنے والے اسٹیشنوں پر وضو
کے لیے پانی دستیاب نہیں ہوتا اور اسٹیشنوں پر گلے ٹھنڈے پانی کے الیکٹریک
کوئلر بند پڑے ہوتے ہیں۔ ریلوے کی بوگیوں میں اکنامی میں موبائل چار
جنگ کی سہولت ہے ہی نہیں جو پہلے اے سی اسٹینڈرڈ میں دستیاب تھی مگر اب
وہاں بھی چار جنگ پوائنٹ بند کر دیے گئے ہیں اور ریلوے کی بگڑتی صورت
حال مسافروں کے لیے مسائل مزید بڑھا رہی ہے۔

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مگر کراچی میں اسموگ کا وجود نہیں تھا نہ بارشیں تھیں بلکہ موسم گرم ہونے کے
باوجود یہاں بھی ریلوے کو اسموگ ہو گئی تھی اور کراچی سے لاہور، فیصل آباد،
راولپنڈی اور اسلام آباد کے لیے روانہ ہونے والی ٹریینوں نے نومبر میں
ریلوے کی ٹریینوں نے تاخیر کا نیا ریکارڈ بنایا جب کہ ٹرینوں کی تاخیر بارش
کے موسم میں ہونا تو معمول ہے مگر اس بار ریلوے کی کارکردگی نے نومبر میں
پی پی کے وزیر ریلوے غلام احمد بلور کے دور کی یاد دلا دی جب وزیر ہوتے
ہوئے ریلوے تباہ ہوئی تھی اور مسلم لیگ (ن) کے دور میں ریلوے کا وزیر نہ
ہونے سے ریلوے پھر بد حال ہے اور (ن) لیگ میں خواجہ سعد رفیق کے بعد
کوئی بھی ایسا رہنما نہیں ہے جسے محکمہ ریلوے میں یہ ذمے داری دی جاسکے۔
محکمہ ریلوے کے پاس 22 گریڈ تک کے اعلیٰ اور دیگر افسروں کی بھرمار
ہے مگر لگتا ہے سب کو مالی مفادات اور مراعات سے دلچسپی ہے کسی کے پاس
محکمہ ریلوے کی بگڑتی صورت حال بہتر بنانے کا وقت ہے نہ انھیں اندرون
ملک ریلوے سے سفر کرنے والے لاکھوں مسافروں کا کوئی خیال ہے۔
محکمہ ریلوے میں ہمیشہ خسارے کا ہی رونا رویا جاتا ہے مگر تقریباً
سالوں سے محکمہ ریلوے کا زور صرف کرائے بڑھانے اور مسافروں کو حاصل
سہولیات ختم کرنے پر ہے اور ٹریینوں میں اکنامی کلاس سے اے سی بزنس
کلاس تک بوگیوں کی حالت وہ نہیں جو ریلوے مسافروں کے لیے سفر مسلسل
مہنگا کرنے اور سہولیات ختم کرنے پر ہے۔ ریلوے میں کراچی کو کونڈے سے
پشاور تک کا طویل دورانیہ کا سفر 36 گھنٹوں تک محیط ہے اور بہت کم ہی
ٹرینیں اپنے مقررہ وقت پر منزل مقصود تک پہنچتی ہیں جن میں سب سے مہنگے
کرایوں اور سہولتیں دینے والی دو ٹرینیں گرین لائن اور سرسید ایکسپریس بھی
شامل ہیں جن کا لیٹ ہونا معمول بننا جا رہا ہے اور ریلوے میں نہ جانے کون
سا اصول لاگو ہے کہ ٹرینیں رات کے وقت کم اسٹاپ ہونے کے باوجود تاخیر
کو دور نہیں کرتیں مگر وہ ہویارات ان کی تاخیر بڑھتی ہی جا رہی ہے جس کی
وجہ یہ ہے کہ تاخیر کے ذمے داروں سے جواب طلبی نہیں ہوتی یا ریلوے کا
ٹرین کے لیے مختص عملہ اپنا اور نام بڑھانے کے لیے تاخیر میں کمی نہیں کرتا اور
جان بوجھ کر ٹریینوں کے سفر میں مزید تاخیر کی جاتی ہے۔ محکمہ ریلوے میں
فاضل مقدار میں ملازمین موجود ہیں اور ہر وزیر ریلوے نے اپنے حلقہ
انتخاب کے ہزاروں افراد کو ریلوے میں وزارتیں دی ہیں اور ریلوے افسران
بھی بڑی تعداد میں موجود ہیں جب کہ تباہ کن بارشوں کو دو سال سے زائد
عرضہ گزر چکا ہے اور بے شمار ٹرینیں بند ہیں اور طویل عرصے سے آہستہ آہستہ
انھیں بحال کیا جا رہا ہے۔
کراچی، کوئٹہ، پشاور و دیگر شہروں سے مین لائن پر چلنے والی متعدد ٹرینیں
اب تک بحال نہیں ہوئیں اور لوپ لائن کے سفر پر جو ٹرینیں چلتی تھیں وہ بھی
بند ہیں یا جو چلائی گئی ہیں ان میں اب مسافروں نے سفر کرنا چھوڑ دیا ہے اور
وہ اب ریلوے کے بجائے بسوں میں سفر کو ترجیح دے رہے ہیں اور خالی



New AI cracks complex engineering problems faster than supercomputers



Modeling how cars deform in a crash, how spacecraft respond to extreme environments, or how bridges resist stress could be made thousands of times faster thanks to new artificial intelligence that enables personal computers to solve massive math problems that generally require supercomputers.

The new AI framework is a generic approach that can quickly predict solutions to pervasive and time-consuming math equations needed to create models of how fluids or electrical currents propagate through different geometries, like those involved in standard engineering testing.

Called DIMON (Diffeomorphic Mapping Operator Learning), the framework solves ubiquitous math problems known as partial differential equations that are present in nearly all scientific and engineering research. Using these equations, researchers can translate real-world systems or processes into mathematical representations of how objects or environments will change over time and space.

"While the motivation to develop it came

from our own work, this is a solution that we think will have generally a massive impact on various fields of engineering because it's very generic and scalable," said Natalia Trayanova, a Johns Hopkins University biomedical engineering and medicine professor who co-led the research.

"It can work basically on any problem, in any domain of science or engineering, to solve partial differential equations on multiple geometries, like in crash testing, orthopedics research, or other complex problems where shapes, forces, and materials change."

In addition to demonstrating the applicability of DIMON in solving other engineering problems, Trayanova's team tested the new AI on over 1,000 heart "digital twins," highly detailed computer models of real patients' hearts. The platform was able to predict how electrical signals propagated through each unique heart shape, achieving high prognostic accuracy.

Trayanova's team relies on solving partial differential equations to study cardiac arrhythmia, which is an electrical impulse misbehavior in the heart that causes irregular beating. With their heart digital twins, researchers can diagnose whether patients might develop the often-fatal condition and

recommend ways to treat it.

"We're bringing novel technology into the clinic, but a lot of our solutions are so slow it takes us about a week from when we scan a patient's heart and solve the partial differential equations to predict if the patient is at high risk for sudden cardiac death and what is the best treatment plan," said Trayanova, who directs the Johns Hopkins Alliance for Cardiovascular Diagnostic and Treatment Innovation.

"With this new AI approach, the speed at which we can have a solution is unbelievable. The time to calculate the prediction of a heart digital twin is going to decrease from many hours to 30 seconds, and it will be done on a desktop computer rather than on a supercomputer, allowing us to make it part of the daily clinical workflow."

Partial differential equations are generally solved by breaking complex shapes like airplane wings or body organs into grids or meshes made of small elements. The problem is then solved on each simple piece and recombined. But if these shapes change—like in crashes or deformations—the grids must be updated and the solutions recalculated, which can be computationally slow and expensive.

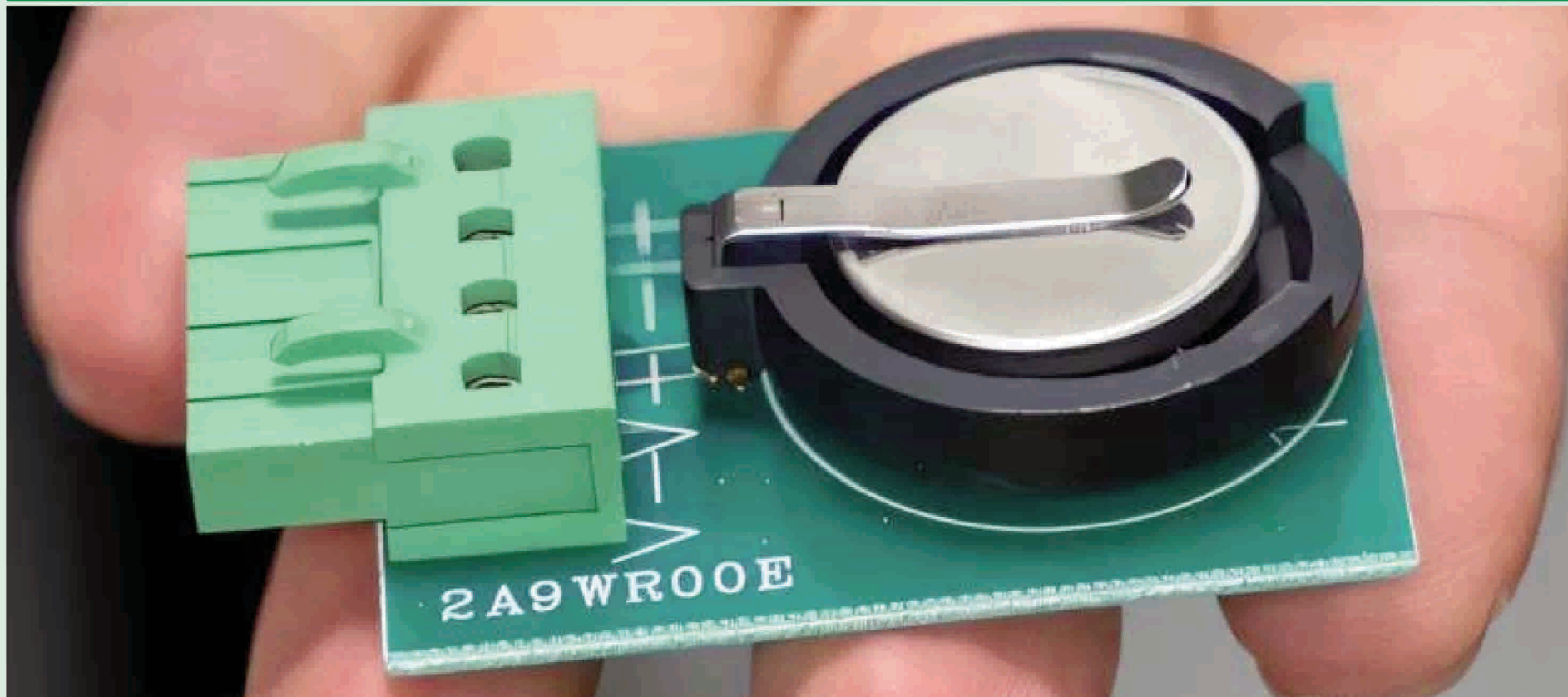
DIMON solves that problem by using

AI to understand how physical systems behave across different shapes, without needing to recalculate everything from scratch for each new shape. Instead of dividing shapes into grids and solving equations over and over, the AI predicts how factors such as heat, stress, or motion will behave based on patterns it has learned, making it much faster and more efficient in tasks like optimizing designs or modeling shape-specific scenarios.

The team is incorporating into the DIMON framework cardiac pathology that leads to arrhythmia. Because of its versatility, the technology can be applied to shape optimization and many other engineering tasks where solving partial differential equations on new shapes is repeatedly needed, said Minglang Yin, a Johns Hopkins Biomedical Engineering Postdoctoral Fellow who developed the platform.

"For each problem, DIMON first solves the partial differential equations on a single shape and then maps the solution to multiple new shapes. This shape-shifting ability highlights its tremendous versatility," Yin said. "We are very excited to put it to work on many problems as well as to provide it to the broader community to accelerate their engineering design solutions." -- TP

Magnesium electrolyte sparks next-generation battery design



University of Waterloo researchers have made a key breakthrough in developing next-generation batteries that are made using magnesium instead of lithium.

When the idea to create batteries using magnesium was first shared in a seminal academic paper in 2000, that novel design didn't provide enough voltage to compete with lithium-ion batteries, which are predominantly used in the marketplace. Magnesium is much more abundant and less costly than lithium, which would help further sustainable energy storage.

Now, the Waterloo team is one step closer

to bringing magnesium batteries to reality, which could be more cost-friendly and sustainable than the lithium-ion versions currently available.

Linda Nazar, a professor in the Department of Chemistry and Canada Research Chair in Solid State Energy Materials, and Chang Li, a postdoctoral fellow in the Nazar Group, have designed an electrolyte that enables a highly-efficient magnesium anode. Li and Nazar collaborated with UC Berkeley and Sandia National Labs for this research.

Their research, "A dynamically bare metal interface enables reversible magnesium electrodeposition at 50 mAh cm⁻²," was published in *Joule* on Dec. 6.

Batteries have three main parts: a cathode

(the positive side of the battery), an anode (the negative side of the battery), and a chemical solution known as an electrolyte that allows the flow of electrical charge between the cathode and anode.

Initial research on magnesium-based batteries generated one volt, less than what a standard AA battery operates at (1.5 volts). The electrolyte that Li and Nazar devised was found to operate at up to three volts with additional improvement expected to come with an even better cathode design.

"The electrolyte we developed allows us to deposit magnesium foils with extremely high efficiency and it is stable to a higher voltage than successfully tested before," said Li. "All we need now is the right cathode to

bring it all together."

While other researchers have had some success in this area, those studies used expensive materials that might be difficult to scale up for commercial use. Li and Nazar's electrolyte design is inexpensive and could be scaled up quickly for the next-generation battery market. It is also non-corrosive and non-flammable, which were both problems with previous electrolyte iterations.

"This is another big step on the road towards commercializing a functional magnesium battery," said Nazar. "We hope our work will open up a door for us, or someone else, to discover and develop the right positive electrode that will complete the magnesium battery puzzle." ■

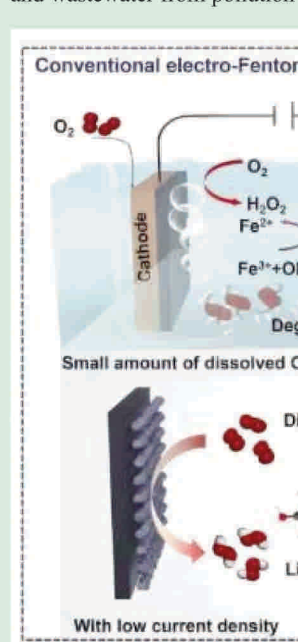
Electrochemical device provides on-site wastewater treatment

Conventional wastewater treatment involves the centralized collection of wastewater from sources through pipes to large-scale treatment plants, where it is treated in bulk. However, this is not feasible in small, decentralized areas such as rural areas.

Simple treatment units installed at small non-point sources of pollution mainly focus on disinfection and turbidity improvement, and do not properly decompose the recalcitrant organic matter in wastewater. In addition, even if industrial wastewater is treated in-house, the treatment efficiency is low, and highly toxic wastewater often needs to be re-transported to a final treatment plant.

Dr. Sang Hoon Kim, Extreme Materials Research Center, Dr. Jong Min Kim, Materials Architecturing Research Center, and Dr. Sang Soo Han, Computation Sci-

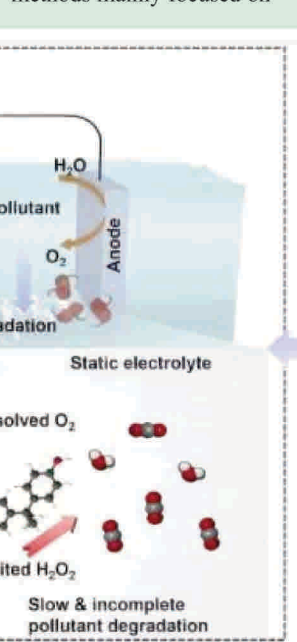
ence Research Center, all from the Korea Institute of Science and Technology (KIST), have developed an electrochemical device that can treat sewage and wastewater from pollution



sites to the level of discharge. In particular, it can rapidly and completely decompose recalcitrant materials into inorganic substances and discharge them on its own.

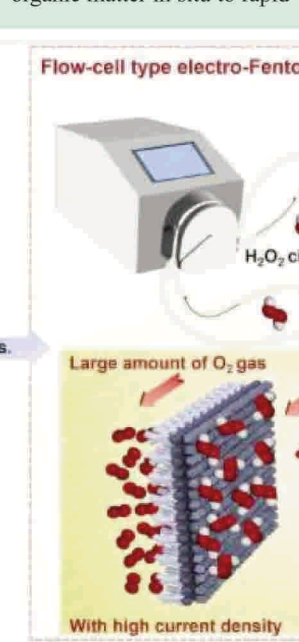
The findings are published in the journal *Applied Catalysis B: Environment and Energy*.

While previous research methods mainly focused on



the development of electrode materials for the generation of hydrogen peroxide, a powerful electrochemical oxidant, this study introduced a flow cell method to generate a

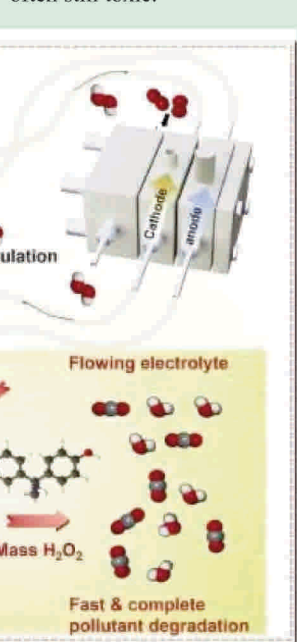
large amount of hydrogen peroxide while circulating wastewater in the device, mixing it well, and oxidizing and decomposing recalcitrant organic matter in situ to rapid-



ly mineralize it. This is a structure that can completely degrade organic matter much more efficiently than conventional treatment tanks.

Conventional oxidation

treatments for harmful organics in water often require multiple steps before the organics are completely degraded, and the intermediate products are often still toxic.



When organic matter in water is completely decomposed and mineralized, it becomes non-toxic and can be discharged, and the indicator of this is called total organic

carbon (TOC).

Since last year, after 48 years, the Ministry of Environment has added total organic carbon to the wastewater discharge standards to impose stricter wastewater treatment standards.

The small-scale electrochemical device developed by the KIST research team is a technology that can effectively treat sewage and wastewater directly on-site, which is difficult to treat centrally, and can effectively reduce the total organic carbon in a short time. In fact, the researchers demonstrated excellent complete decomposition performance, reducing the total organic carbon of 50ppm bisphenol A by 93% in two hours.

"The developed device is composed of a continuous and repetitive flow method, which shows higher complete decomposition efficiency than the existing method, and a patent is pending for the device and processing method. We are also planning to transfer the technology to commercialize it." -- TP ■